POWER TOPICS CROSS-INDEX

STEAM GENERATION
POWER GENERATION
WATER POWER
DIESEL & GAS ENGINES
AIR CONDITIONING & HEATING
REFRIGERATION
PUMPS & COMPRESSORS
STEAM SERVICES
ELECTRICITY & ELEVATORS
INSTRUMENTS & CONTROL
PIPING SYSTEMS
MECHANICAL TRANSMISSION
POWER MISCELLANY

VOLUME 83 NUMBER 7

POWER

N. O. WYNKOOP, *Publisher*
PHILIP W. SWAIN, *Editor*

Associate Editors
F. A. ANNETT
S. A. TUCKER

E. J. TANGERMAN, *Consulting Editor*

Assistant Editors
B. E. SAWYER
L. N. ROWLEY

PAUL WOOTON, *Washington* G. C. TENNEY, *San Francisco* H. S. KNOWLTON, *Boston*

JULY, 1939

The last word in brewery power—Jacob Ruppert plant..... 58
Carbon-dioxide gas cools large high-speed motors..... 62
28 answers to your dust-collection problem—Part II..... 64
Silver-plating algae—a new way of controlling slime..... 68
How and why of escalators—review of today's practice.... 69
Yardstick for new standards in selecting leather belts..... 73
How gravity and force-feed lubricating systems work..... 76
More hp per lb—prime-mover developments in Europe..... 78
Six million sq ft to heat—Bush Terminal plant..... 81
How to figure total suction lift on centrifugal pumps..... 84
Three steps to better indication of diesel engines..... 86
2000-lb pressure for Brimsdown (England)—photo page.... 89

THE OPERATING ENGINEER

Operators Go to School.. 93
Ash Protects Grate..... 95
Charging Ammonia 96
It's Still Your Baby..... 97
Practical Aids 98
Readers' Problems 102
Argument Corner 105
Headwork Section 106
Questions and Answers.. 107
How to Seize Wire Rope. 108

OTHER DEPARTMENTS

Exhaust Lines 67
Speaking of Power..... 72
Power Lines, News Notes. 110
Data Sheet No. 84..... 120
New Plant Equipment.... 122
George Edwards 128

Publication office: 99-129 North Broadway, Albany, N. Y.
Editorial & Executive Offices: 330 West 42nd St., New York, N. Y.

A McGRAW-HILL PUBLICATION

JAMES H. McGRAW, Founder and Honorary Chairman

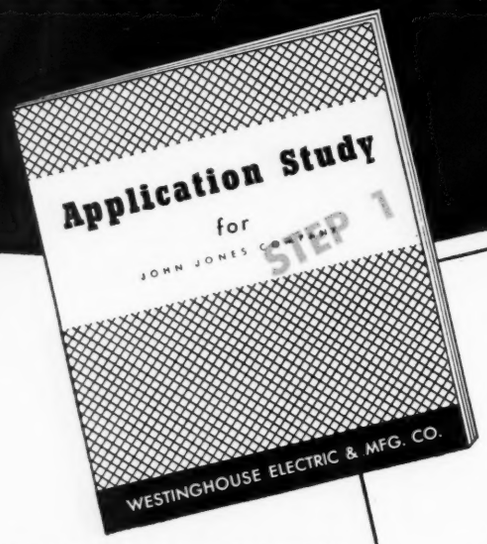
JAMES H. McGRAW, JR., President
HOWARD EHRLICH, Executive Vice-President
MASON BRITTON, Vice-Chairman
B. R. PUTNAM, Treasurer
D. C. McGRAW, Secretary
J. E. BLACKBURN, JR., Circulation Manager

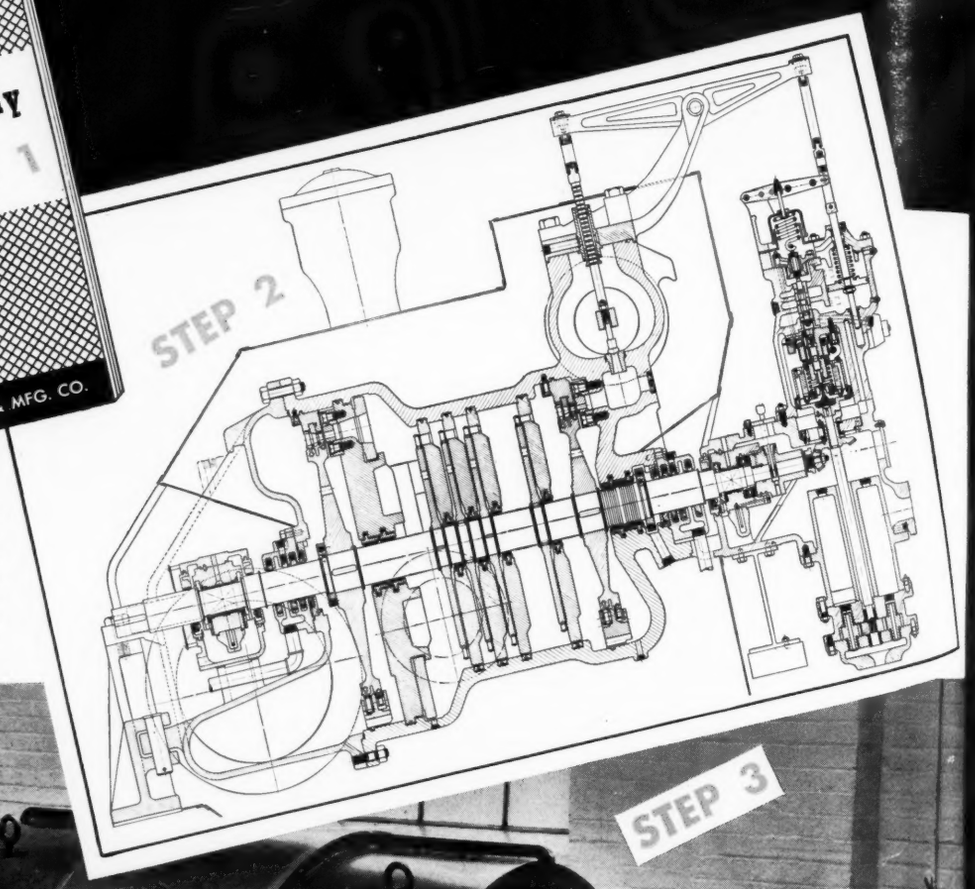
CHICAGO, 520 North Michigan Ave.
SAN FRANCISCO, 883 Mission St.
WASHINGTON, National Press Bldg.
PHILADELPHIA, 16 South Broad St.
CLEVELAND, 1510 Hanna Bldg.
DETROIT, 2-144 General Motors Bldg.
ST. LOUIS, 455 Paul Brown Bldg.
BOSTON, 1427 Statler Bldg.
ATLANTA, 1105 Rhodes Haverty Bldg.
LONDON, Aldwych House, Aldwych, London, W C.2

Copyright, 1939, by McGraw-Hill Publishing Company, Inc.

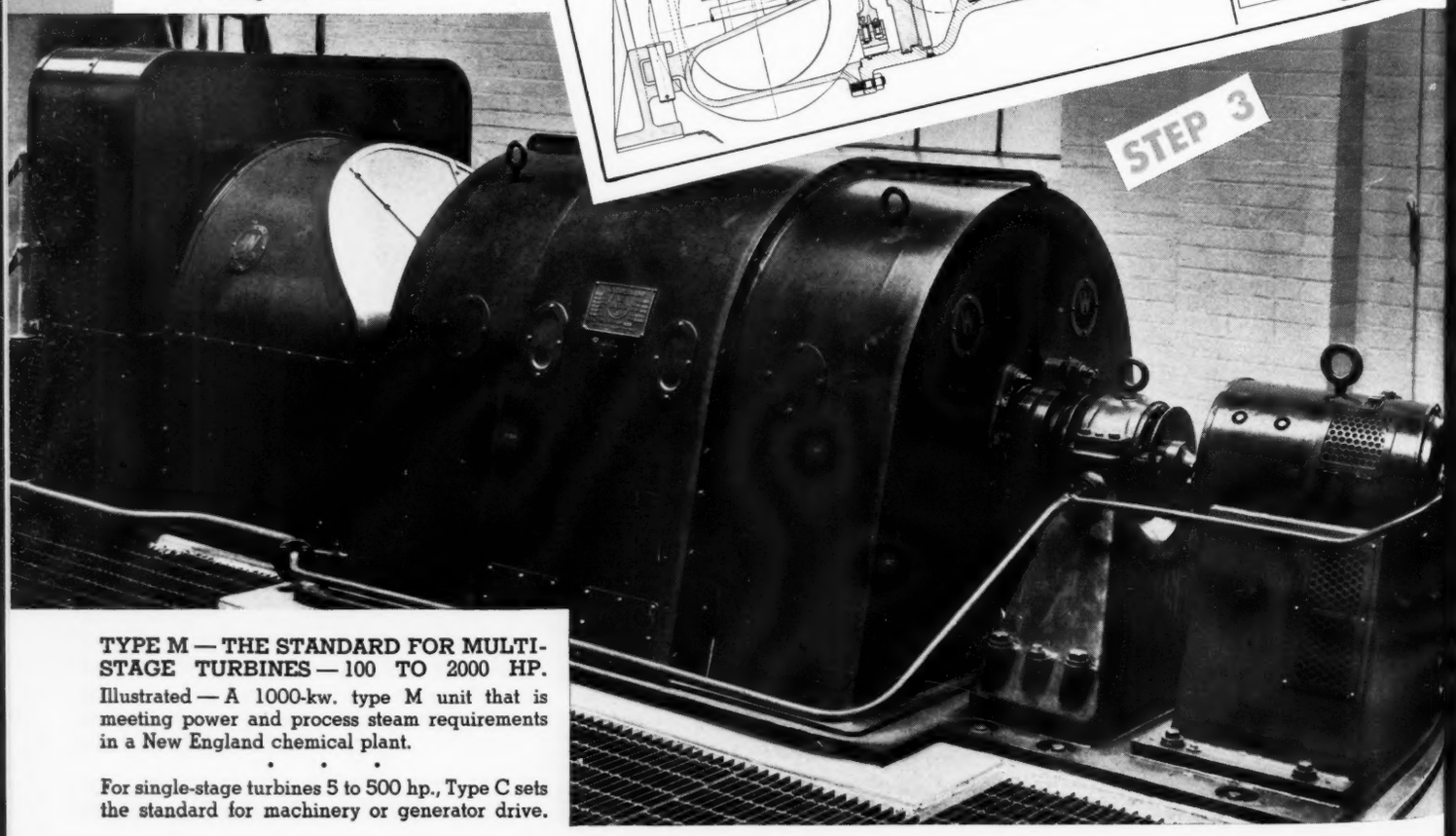
POWER articles are currently indexed in both the Industrial Arts and the Engineering Indexes, available at public libraries. Also every year POWER issues an annual index of its own. Cable Address: "McGraw,Hill, N. Y."

Make Steam Headquarters





The three steps in meeting a specific problem at Steam Headquarters. 1—Analysis of steam and power conditions to be met — and process needs where they are involved. 2—A design that fulfills the requirements — economically — dependably. 3—The completed turbine.



TYPE M — THE STANDARD FOR MULTI-STAGE TURBINES — 100 TO 2000 HP.
Illustrated — A 1000-kw. type M unit that is meeting power and process steam requirements in a New England chemical plant.

• • •

For single-stage turbines 5 to 500 hp., Type C sets the standard for machinery or generator drive.

Westinghouse *Complete*

POWER

Established 1882 PHILIP W SWAIN, Editor

Our Inescapable Responsibility

If the United States went to war tomorrow, or widespread industrial trouble developed, what would happen to our power plants?

In 1917, we had practically no protection against sabotage. Even after two decades, we still have none. Saboteurs could have a Roman holiday with our power systems, for we have not anticipated them.

What could our big cities do without power for a week or more? Everything from clocks to transportation must stop. No lights. No elevators. And in most cities no water. No sewage pumping. The four fantastic horsemen—Famine, Pestilence, War and Death—again would ride together.

Off hand, this sounds like sensationalism, but it is basic fact. Big city after big city has narrowly averted serious trouble due to power failure for one cause or another. New York got a taste of it when Hell Gate went out; Long Island a worse taste when the hurricane struck last fall; Louisville and nearby towns the worst taste of all during the flood two years ago.

But none of these is a patch on what might happen during a systematic campaign against the sources of our major power supply. We can protect against isolated, sporadic bombing raids—the damage they cause is usually readily repairable. But what is to stop a series of planned attacks against the "hearts" of power stations—the wrecking of vital spots?

England has only just awakened to her danger. We are still asleep. We have "locked" switch galleries that are never locked, power plants posted but not guarded against trespassers, little or no adequate system for checking up disaffected former employees. Our power plants—and systems—are open to all.

These things should not—must not—be. Power is too vital in our modern civilization for us to take the slightest chance of its failure. It is time *now* to get our house in order, to prepare for any eventuality.

Unbelievable as it sounds, it *can* happen here. No one can predict, or prevent, the "normal" power failures. But we can do much to prevent the planned ones. Perhaps, instead of guarding so fanatically the repositories of gold and silver at San Francisco, Fort Knox and West Point, we should plan some protection for that vastly more important source of our wealth—power. If the Dies Committee can spend a quarter of a million dollars to prove the existence of this potential danger, is it not the responsibility of every industrial and utility power-plant operator to apply common-sense methods to protect his charge?

Last Word in Brewery Power

New Jacob Ruppert plant combines modern equipment in hookup that takes advantage of byproduct-power possibilities

SUPPLYING ELECTRIC POWER, process steam, and refrigeration to Jacob Ruppert Brewery, New York, this new power plant demonstrates forcefully how savings can be made by combining modern equipment in an intelligent power-process hookup. Here is the story behind power modernization; a later article will describe the new refrigeration plant.

In the 32-year-old plant just replaced, 5 stoker-fired boilers supplied steam at 125 lb to a turbine, engines, steam-driven ammonia compressors, and process. By the time new boilers, extraction turbines, motor-driven compressors, and electric equipment receive finishing touches, virtually all old equipment will have been removed. Entire construction program has been carried through without interruption of power services vital to brewery operation.

Flow diagram shows one great source of savings in new plant: hookup takes full advantage of byproduct-power possibilities while making ingenious provisions for flexibility. Designers faced this problem: supply brewery power loads, including new motor-driven compressors; process steam at 125 lb for auxiliary drives, sterilizing and washing; process steam at 30 lb for cooking and heating; and steam at 10 lb for building and water heating; all with a minimum of steam going to condensers. Proof of designers' success lies in early operating results—only a little more steam goes to condensers than needed to cool low-pressure blading.

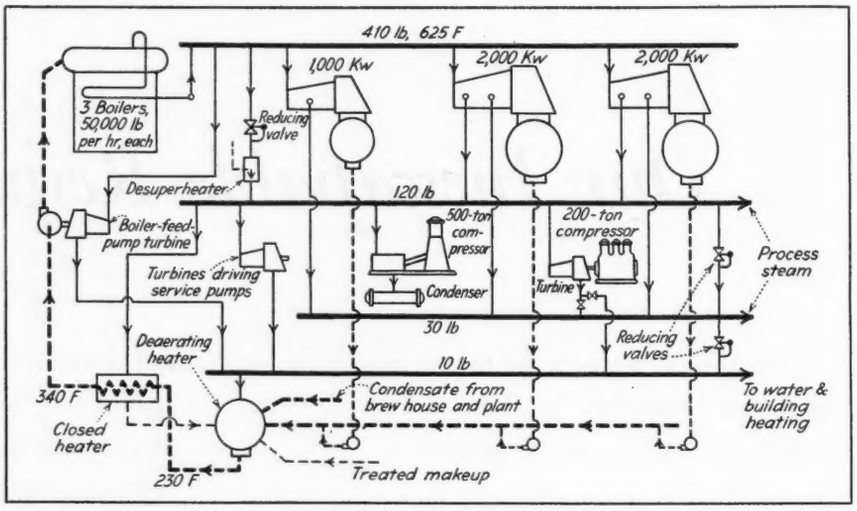


Fig. 1—Power-process hookup

Power-Process Balance

Steam from three 50,000-lb-per-hr boilers at 410 lb and 625 F, supplies two double-extraction condensing turbines, a single-extraction unit, also condensing, and a turbine driving one of three boiler-feed pumps. Under normal conditions, one 2000-kw turbine serves as standby; combinations of remaining two units meet wide range of load efficiently, with large machine handling base loading and small unit serving extremely light loads or peaks above capacity of 2000-kw unit. Condensers on all units give complete interchangeability in operation; circulating water comes from a large cooling tower (see future refrigeration article for details).

Changes in brew house made it possible to cook with 30-lb steam instead of 125 lb, as formerly required; this increased demand at lower pressure level. Thus all turbines bleed at 30 lb, but only large units extract at 125 lb. Balance between three process levels results from retaining one 500-ton direct-acting angle-type ammonia compressor and driving one of new vertical compressors (200-ton) by a turbine taking steam at 120 lb and exhausting to either 30-lb or 10-lb header. Normally this unit exhausts to 10-lb system and pressure in 10-lb header regulates speed of turbine so that its exhaust meets requirements at that level; refrigeration loads solely control operation of other motor-driven compressors. Boiler-feed-pump and service-pump turbines also exhaust to 10 lb.

Seasonal changes account for biggest variations in refrigerating load, which ranges from practically nothing in winter to a peak in summer. The 500-ton compressor will help carry summer peaks directly by adding to refrigerating capacity, and indirectly by increasing 125-lb steam demand in relation to electrical load. Since process loads stay about the same all year round, lack of refrigerating load in winter makes it impossible to utilize all power which could be generated as a byproduct of process steam with throttle conditions at 410 lb and 625 F. Therefore, in winter operators will drop pressure to about 350 lb.

Jacket water from compressors, other drips and drains, and city water compose makeup which is treated in an automatically controlled zeolite system before admission to deaerating heater. Only further water treatment takes place in drums.

New 2-drum boilers generate 50,000 lb per hr continuously, or 70,000 lb per hr for 2 hours. Two boilers can handle all loads; this allows running each unit 2 weeks with 1 week out. Two pulverized-coal burners, fitted with mechanical atomizing oil nozzles, fire into each water-cooled, plain-tube furnace. This combination proved its worth in the recent coal crisis, when ability to fire oil made it possible to continue operation in spite of rapidly waning coal supply. Under normal conditions, choice of fuel will depend on competitive prices.

Completely separate systems handle coal from bunker to each boiler; three downspouts connect 1000-ton suspended steel bunker with 100-lb dump coal scales on operating floor, above feeders and motor-driven bowl mills in basement. Trucks deliver coal to plant at street level, dumping to reciprocating feeder ahead of crusher; conveyor lifts fuel to bunker. A pneumatic sluice removes ash from hopper under furnace-bottom screen, and flyash collectors.

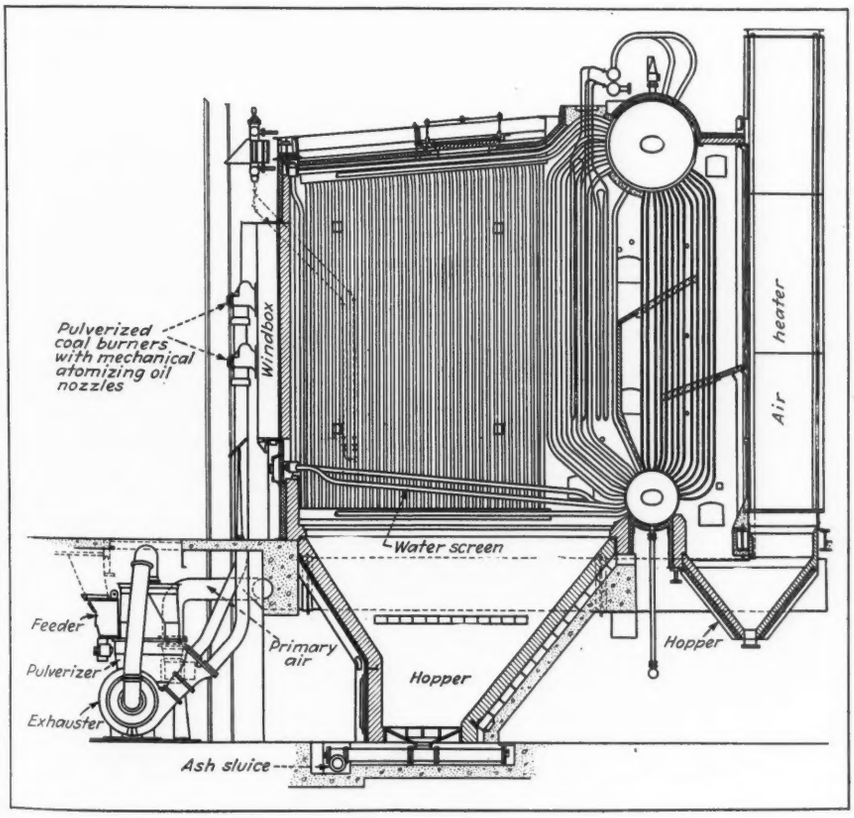
One oil-handling system, with two 20,000-gal. storage tanks and duplicate motor-driven pumps, strainers, steam heaters, and interconnecting piping, serves for oil firing and as ignition for pulverized coal. A third pump keeps oil circulating constantly. At present, use of steam atomization during first few hours of firing, until furnace conditions equalize, prevents smoking. Operators intend to change to wide-range mechanical-atomizing burners later.

Hydraulic couplings on all fans give variable speed with constant-speed motors. Operation (described in detail in *Power*, July 1938) is simple; a reversible motor-driven pump forces oil into or out of coupling; speed depends on amount of oil present. A forced-draft fan on each boiler pushes air through preheater to supply primary and secondary requirements. Gas from three boilers goes into a common duct; two compound-cyclone dust collectors and two induced draft fans, in parallel, handle gas from this duct to stack. Dust collectors employ Van Tongeren principles (see page 64).

A complete automatic system centralizes control of boilers and associated equipment. Features of plant design such as use of hydraulic couplings, dust collectors, two induced-draft fans for three boilers, introduce novel control problems; the diagram shows how they are solved. Essentially, the system consists of a supermaster control actuated by pressure in main steam header, and a master control for each boiler. Regulators with air-operated cylinders carry out actual control operations.

According to setting of ratio adjusters, supermaster control divides load among boilers in any desired proportions; master control on each boiler maintains best fuel-air ratio over entire load range. By use of transfer levers, operators may go instantly from automatic to manual control and with equal ease from coal to oil fuel.

Fuel-feed controls are more or less conventional, but use of hydraulic couplings calls for different set-up to regulate air flow. Air-flow regulator balances differential pressure across air heater against master-loading pressure, varying fan speed and damper position as required. Damper operates in a narrow range, and regulator actuates contactors on oil pump when damper reaches limit. Oil pump forces oil into or out of hydraulic coupling to change fan speed and restore damper to regulating range. Furnace-pressure regulators, actuating dampers in each boiler uptake, maintain constant pressure in each furnace. For safety, a special regulator goes into action if boiler pressure becomes positive due to draft-equipment failure. This unit opens electrical circuit of forced-draft-fan motor and, through an electrical interlock, shuts down pulverizer.



Pulverized-coal and oil-fired 2-drum boiler

Space limitations dictated use of common duct for boiler gases, but this arrangement produced a smaller and cheaper flue-gas-handling plant. Use of two fans and dust collectors fits neatly into plan to operate only two of boilers at a time; one fan and collector will handle most of loads with other units available to share heavy loads. It can be seen that fans must operate, in relation to combined boiler load, to keep suction in the duct such that boiler-uptake dampers will always be in good regulating range. A single regulator, loaded from the supermaster panel, controls fan speed by actuating contactors on hydraulic-coupling oil-pump motors.

Fan Controls

Control arrangement permits selecting either fan to carry load and will automatically start second fan when first reaches maximum speed. Electrical controls start the standing fan when oil level in the hydraulic-coupling-oil-storage tank of the running fan falls to a predetermined low point. When both fans are running, a balancing unit automatically adjusts fan speeds so that each carries half of total load.

Damper actuators insure full closing of damper on idle fan when only one fan is running, preventing gas leakage and poor regulation of running fan. If idle fan cuts in when running fan reaches maximum, actuator opens damper when speed of incoming fan approaches that of running fan. A pair of regulators, responsive only to differential pressure, actuate dust-collector dampers, holding constant differential required for best efficiency.

Among the first units of their type, the two 2000-kw turbines are designed for automatic control of frequency and pressure at both bleed points. A hydraulic-transformer governor controls flow of throttle steam through impulse blading to a steam space from which 120-lb steam is bled. A multi-port grid valve actuated by a servo-motor controls flow from this space to following impulse and reaction blading; a similar arrangement regulates steam flow from 30-lb steam space to last stages of turbine and to condenser.

A regulator on each extraction line reacts to changes in bleed-steam pressure, sending hydraulic impulses to grid-valve servo-motors and to main governor. If increased demand for steam, at say 120 lb, causes drop in pressure, regulator closes grid valve slightly, impeding flow to blading beyond valve and raising pressure in steam space ahead of valve. This forces more steam out at extraction point, meeting increased demand. Regulator

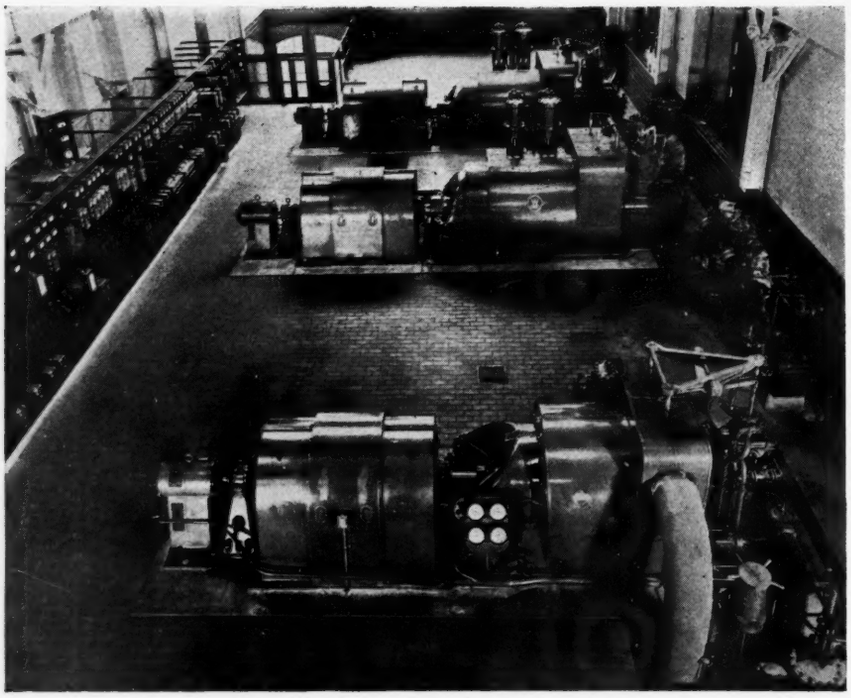


Fig. 3—Turbine room at Jacob Ruppert Brewery: 100-kw single-extraction unit in foreground, two 2000-kw double-extraction machines in rear

also changes setting of main governor to increase total steam flow, compensating for increased extraction and maintaining frequency. Adjustments to meet variations in process-steam and power demand are met automatically, within limits of total throttle and extraction flows.

The 1000-kw turbine provided the link between old plant and new. Its installation in 1937 permitted removal of old generating equipment; supplied with steam at 120 lb, and bleeding at 30 lb, it could meet the electrical load which had not then been increased by installation of motor-driven compressors. With new boilers and turbines in service, changes in high-pressure wheel converted the machine to 400-lb operation, its present service. A mechanical governor controls throttle flow to impulse stages, and a single multi-port grid valve, automatically regulated from extraction-line pressure, controls flow to 8 Rateau stages between bleed point and condenser.

Reducing and desuperheating equipment between 410-lb and 120-lb headers

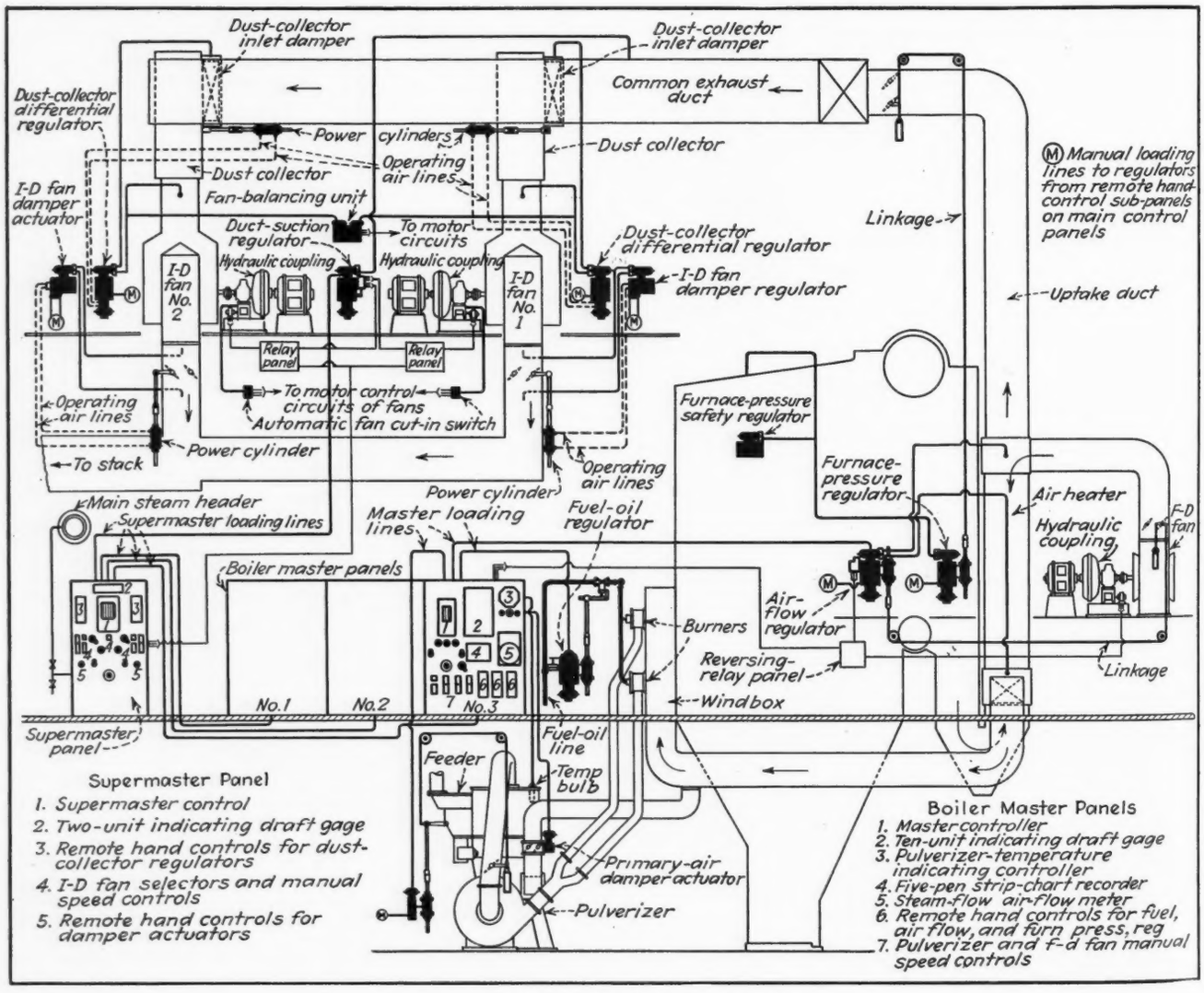


Fig. 4—Control diagram for boilers and auxiliaries

handles fluctuation in process-steam requirements beyond range of turbine extraction flows and stands ready to bypass turbines if necessary. Diagram shows arrangement of this completely automatic system.

Two reducing valves, of 45,000 and 15,000 lb per hr capacity, operate in parallel ahead of a steam-atomizing desuperheater rated at 60,000 lb per hr. Setting regulator for 2½-in. valve to maintain a slightly higher pressure (115 lb) than regulator for 4-in. valve (112 lb) insures that smaller valve will operate first, up to limit of capacity. Linkage from power cylinders operates water shut-off valves; arrangement permits small quantity of water to pass 2½ in. valve to cool, under control of temperature-regulating valve, any steam leaking past reducing valves.

In the desuperheater, high-pressure steam atomizes water taken from high-pressure feedwater system. A recording temperature controller automatically regulates water flow to maintain desired steam temperature; diagram shows temperature bulbs, diaphragm-motor valve and temperature indicator and alarm system. A restricting orifice in the atomizing-steam line passes required amount of high-pressure steam and a steam shut-off valve, connected to the pressure regulators, prevents flow of atomizing steam until one or the other reducing valve opens. Desuperheater control panel permits transfer of desuperheater-water control from automatic to manual.

Reliability was the keynote in layout of new electrical system. Two 1000-kva, 2200/220-volt transformers tie completely separate bus systems together; transformers can be completely isolated by high- and low-tension circuit breakers so that transformer faults will not affect operation of system. Connecting 1000-kw turbine-generator to low-tension bus and two 2000-kw machines to 2200-volt bus further insures against failure due to bus or transformer faults.

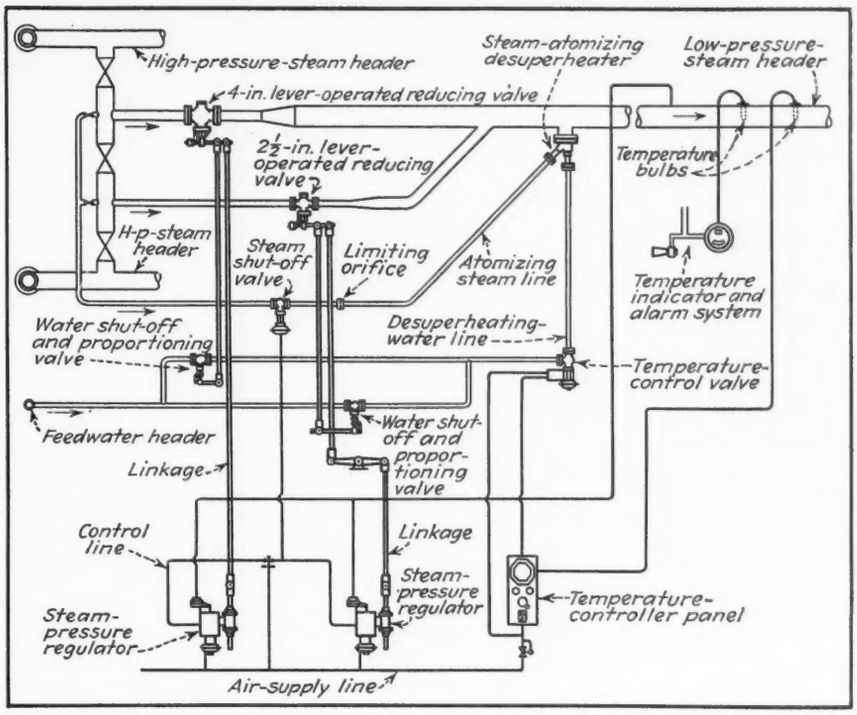


Fig. 5—Diagram of reducing and desuperheating equipment

All switchgear is in basement of power house; high-tension equipment is vertical lift-up type with high-interrupting capacity-breakers having De-ion arc extinguishers; low-tension switching is handled by carbon circuit breakers mounted on vertical panels of ebony asbestos and provided with disconnect switches. Main control board, located in turbine room, mounts all metering instruments, protective relays, control switches, and voltage regulators. An automatic synchronizer closes incoming breaker when a machine is being paralleled, eliminating possibility of operator bringing in machine out of phase.

Three motor-generator sets (rated 500, 300, 200-kw) furnish direct current for power purposes in some parts of brewery and for truck charging. Synchronous motors, on these sets and on four 300-ton ammonia compressors, correct the pf, bringing it close to unity.

Consulting engineers for the power-plant modernization were Burns & Roe, Inc; William L. Schuler, plant engineer, was in charge for Jacob Ruppert. New plant will be operated by Charles Arians, chief engineer.

Principal New Power Plant Equipment

JACOB RUPPERT BREWERY—NEW YORK

Steam-Generating Equipment:
Boilers, 3, 2-drum, bent-tube, 5335 sq ft.....Combustion Engineering Co, Inc
50,000 lb/hr continuous, 410 lb, 625 F; welded drums, steam washer
Superheater, Elesco intertube, 815 sq ft.....Combustion Engineering Co, Inc
Furnace, 2575 cu ft.....Combustion Engineering Co, Inc
Plain-tube waterwalls, 1230 sq ft, water-screen hopper bottom
Air heater, tubular.....Green Fuel Economizer Co
Steam-flow air-flow meters.....Bailey Meter Co
Soot blowers.....Diamond Power Specialty Co
Safety valves.....Consolidated-Ashcroft-Hancock
Blowoff valves.....Yarnall-Waring Co
Water columns.....Diamond Power Specialty Co
Boiler settings.....Combustion Engineering Co, Inc
Includes structural steel, steel casings, insulation and soot hoppers
Continuous blowdown system.....Permutit Co

Combustion and Fuel-Handling Equipment:
Pulverizers, 3, Raymond bowl-mill.....Combustion Engineering Co, Inc
Temperature controller, coal-air mixture.....Foxboro Co
Coal scales, 100-lb dumps.....Richardson Scale Co
Burners, 2 per boiler.....Combustion Engineering Co, Inc
Coal bunker and handling equipment.....Gifford-Wood Co
Ash-handling system, pneumatic sluicing.....Hydro-Ash Corp
Fuel-oil pumps.....Quimby Pump Co
Fuel-oil strainers.....Andale Co
Fuel-oil meters.....National Meter Co
Fuel-oil burners, mechanical-atomizing.....The Engineer Co

Draft Equipment and Combustion Control:
Forced-draft fans, 3, 22,760 cfm each.....Green Fuel Economizer Co
Induced-draft fans, 2, 44,500 cfm each.....Green Fuel Economizer Co
Hydraulic couplings, all fans.....American Blower Corp
Flyash collectors, compound cyclone.....Buell Engineering Co
Ductwork, breeching.....Baker-Smith Co
Combustion control, full automatic, Smoot....Republic Flow Meters Co

Feedwater System and Piping:
Boiler-feed pumps, 3.....Worthington Pump & Machinery Co
2 motor-driven, 75,000, 100,000 lb/hr; 1 turbine-driven, 100,000 lb/hr
Deaerating heater.....Hoppes Mfg Co
Closed heater.....Alco Products Div, American Locomotive Co
Feedwater regulators; copes.....Northern Equipment Co
Water-treating system, zeolite.....Permutit Co
Softener booster pumps.....Ingersoll-Rand Co
Low-level storage pumps.....Ingersoll-Rand Co
Valves, steam and water.....Wm Powell Co
Piping, steam and water.....Baker-Smith Co

Turbine Plant:
Turbine-generator; 2, 2000-kw, 3600-rpm...Westinghouse Elec & Mfg Co
Automatic double extraction, at 120 lb and 30 lb, condensing
Condensers, 2, 3000 sq ft.....Westinghouse Elec & Mfg Co
Generator air coolers, 2, 625 sq ft.....Westinghouse Elec & Mfg Co
Turbine-generator, 1000-kw, 3600-rpm....Westinghouse Elec & Mfg Co
Automatic single-extraction, at 30 lb; condensing
Condenser, 1900 sq ft.....Westinghouse Elec & Mfg Co
Generator air cooler, 480 sq ft.....Westinghouse Elec & Mfg Co
Turbine instrument panels.....Republic Flow Meters Co
Main reducing valves, 2½-in. and 4-in.....Republic Flow Meters Co
Desuperheater, 60,000 lb/hr, steam-atomizing..Republic Flow Meters Co
Regulators and controls for reducing station..Republic Flow Meters Co

Electric Equipment:
Bus-tie transformers, 1000 kva, 2200/220 volts
Westinghouse Elec & Mfg Co
Motor generators, synchronous, 200 kw, 300 kw
Westinghouse Elec & Mfg Co
Switchgear and control board.....Westinghouse Elec & Mfg Co
Motors.....Westinghouse Elec & Mfg Co
Motor starters.....Westinghouse and Cutler-Hammer, Inc
Electrical construction.....Van Der Leith and Lexington Electric Co

Inert Gas Cools Large Motors

Carbon-dioxide cooling in closed-circuit ventilating system licks explosion hazard for large high-speed motors

By C S MERRILL
Industrial Dept, General Electric Co

ELECTRIC MOTORS for modern oil refineries are built in large capacities and must be able to operate in gaseous atmospheres without being explosion hazards. Fan-cooled explosion-proof constructions have been limited to approximately 400 hp at 1800 rpm, but base- and pipe-ventilated motors can be built up to 4000 hp. Base-ventilated motors depend upon a supply of pure air led to the motor through ventilating ducts. Space needed for long ventilating ducts to supply pure air to this type of motor is a serious objection to this design.

The inert-gas-filled induction motor combines advantages of the self-contained fan-cooled explosion-proof machine with the large ratings of the base-ventilated design. Two of these induction motors, rated 1000 hp at 3000 rpm and with a closed-circuit ventilating system filled with carbon dioxide, drive the main hot-oil charging pumps in the new $5,000,000 addition to the Richfield Oil Refinery, Watson, Calif. Motors of this design can now be built up to 4000 hp.

One of the motors is shown in Fig. 4. This design has a closed-circuit system of ventilating, incorporating surface air coolers for removing the heat, and a valve arrangement for occasionally injecting a small amount of carbon-dioxide gas into the cooling system. This feature, together with a tight enclosure and special seals, provides the operator with a complete arrangement for maintaining a noninflammable atmosphere slightly above atmospheric pressure within the motor.

Fig. 1 is a general cross-sectional view of the motor interior, showing arrangement of cooler tubes and direction of gas flow. Coolers are attached to the sides of the motor; water-filled cooling tubes run vertically. From each cooler, CO_2 is directed by the cooler casing back into each end of the motor frame, as indicated by the arrows. Here a cast-iron deflector forms an orifice in which a propeller fan forces the gas axially between the rotor and stator, from where it passes

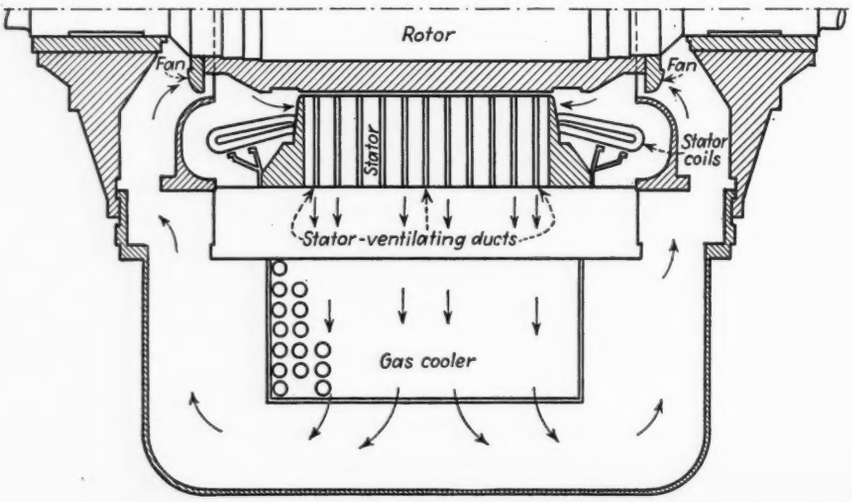


Fig. 1—Horizontal cross section through one half of a motor showing internal method of ventilation and the flow of gas through the motor and coolers where it is cooled by water

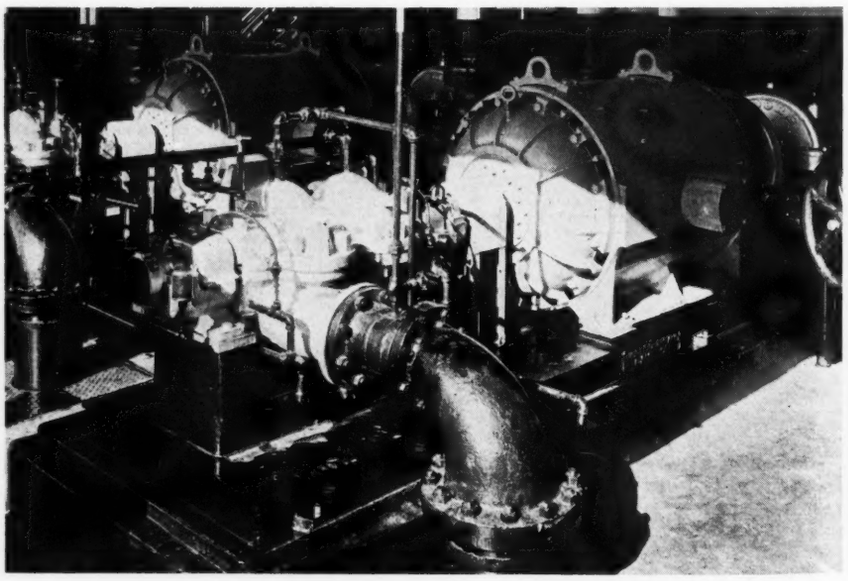


Fig. 2—Two 250-hp, 3000-rpm, explosion-proof, totally inclosed, fan-cooled squirrel-cage motors for hazardous-gas locations driving cold-crude-oil charging pumps

through radial ducts in the core and is directed back to the cooler.

Bearing lubrication and sealing the shaft at each end against gas leakage are coordinated into one system consisting of the motor bearings, oil-reservoir tank, oil-pumping unit, and piping. A schematic section of each motor bearing is shown in Fig. 3. To lubricate the journal, oil under pressure is pumped up through a hole drilled in end shield and bearing feet, and enters the bearing at a horizontal split through an orifice plug. Oil flows over the top of the shaft in the direction of rotation and is distributed by grooves in the top half of the bearing from where it is wiped into the lower ungrooved half. A major portion of this oil, however, flows out at the opposite horizontal split through a hole in the end shield similar to the inlet hole and is returned to the reservoir. All end leakage from both ends of the journal proper is drained to the air side of the bearing housing, and from there to the reservoir tank.

Bearing Gas Seal

The gas seal is built as part of the bearing on its gas end. It comprises an annular space around the shaft in which high-pressure oil is supplied. This oil is tapped off from the main supply by a hole drilled in the body of the bearing. A needle valve regulates the oil flow, if necessary. Oil flowing from the sealing groove toward the bearing is drained to the air side of the bearing housing. Oil forced toward the motor against gas pressure flows into the gas side of the bearing housing, from where it is drained.

The oil tank is divided into two parts by a vertical diaphragm, with means for transferring oil from one side to the other. One side of the tank is sealed and connected to the motor case by a pipe. Oil drainage from the gas side of each bearing housing connects into this side of the tank. The other side of the tank is vented to atmosphere through the filler cap. To this side of the tank, high-pressure oil from each bearing, drainage from the air side of the bearing housings, and bypassed oil from the pump are returned.

An auxiliary pumping unit of two separately driven pumps is furnished for each motor. These provide a supply of oil for each bearing and seal, and run continuously to maintain gas pressure in the motor, whether the main motor is running or not.

Inert gas is supplied to the motor from a standard commercial cylinder of CO_2 or, if necessary, some other high-pressure supply through reducing valves. When starting for the first time, the motor enclosure is exhausted of air and filled with inert gas by admitting gas at the bottom and allowing air to exhaust from the purging valve at the top of the motor. This simple method can be followed because the gas is heavier than air.

Stator windings of these motors are so designed and braced and the starting current is of such a value that the motors may be started on full voltage. A standby turbine connects directly to the motor shaft and automatically picks up load at 150 rpm below motor speed, if there is a power interruption. When starting, the motors come up to full speed in less than 30 sec after closing the line switch.

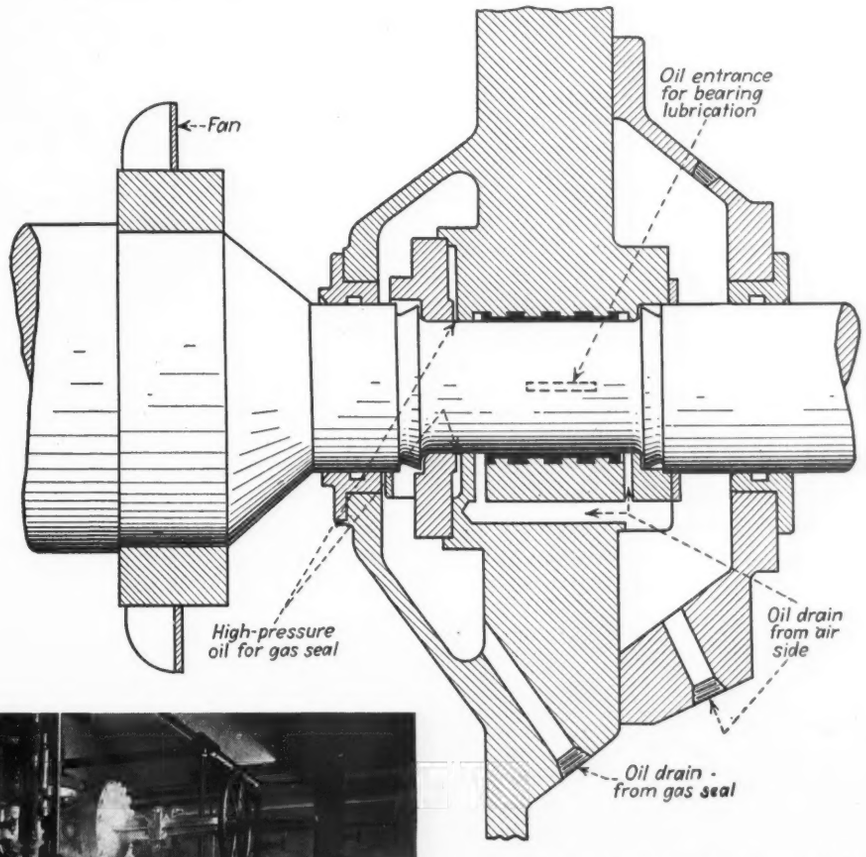


Fig. 3—Cross section of one of the motor bearings, lubricated by oil under pressure. Pressure oil is also used in the gas seal around the shaft

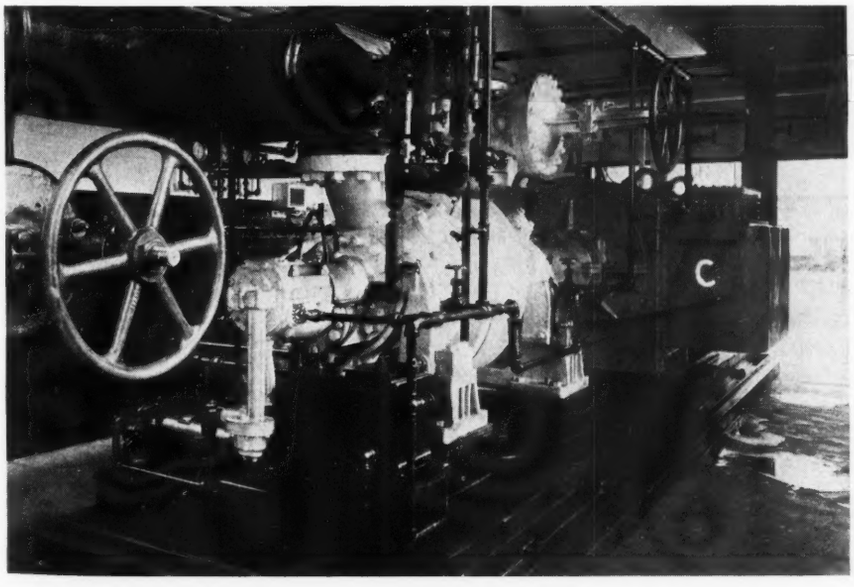


Fig. 4—One of two 1000-hp, 3000-rpm, totally inclosed, inert-gas-filled, squirrel-cage motors driving hot-oil charging pumps. One of the two gas coolers attached to side of motor is at C

28 Answers to Your Dust-Collection Problem

II

An article in June POWER discussed filters and scrubbers for cleaning boiler flue gas. Typical cyclone and electrostatic equipment complete the survey

By R T ROBERTS, *Asst Division Engineer, Consolidated Edison Co of New York, Inc*

EXCLUSIVE OF FILTERS and scrubbers, dry-type cinder and fly-ash collectors comprise numerous designs and equipment. These separate naturally into two classes: (1) those in which separation is accomplished by the mass or inertia of the particle and (2) electrostatic precipitators.

Of the first class, the most common is the simple cyclone with or without auxiliary dust concentrators. Cinder-catching fans do a dual service with attendant variations in design features and have relatively low efficiency. Because they do not have wide application to modern boiler types, they are not discussed here.

Cyclones are capable of high efficiency at reasonable draft loss if the gas quantity to be handled is not too great, that is, the diameter of the individual cyclone should not be large. Efficiency is better with heavy dust loading and large particles.

As cyclone size increases to handle larger gas quantities, it becomes increasingly difficult to throw the particles of dust across the gas stream to the scroll where they can be separated and collected. Also, larger cyclones require higher draft loss for comparable efficiency. A common type of cyclone is shown in Fig. 14.

To increase the efficiency of the single cyclone, one manufacturer installed skimmer slots in the outlet, Fig. 15. This cyclone is designed on the theory that after preliminary precipitation, gas carries the escaping dust concentrated in the outer layer, due to centrifugal action. This layer is skimmed off and returned to the cyclone inlet.

Another manufacturer draws the escaping gas through four small cyclones located in the head of the main unit. While these schemes undoubtedly give some increase in efficiency, neither system has yet been employed on a major installation, and therefore only meagre information is available.

Fig. 16 shows a cyclone with a skimmer in the scroll. This type skims off the dust from the periphery of the cyclone, and leads it through an external channel to the dust hopper. The collection guarantee is as follows:

Particles	over	60	microns—99+%
Particles	over	40	microns—99%
Particles	over	20	microns—95%
Particles	over	15	microns—90%
Particles	over	10	microns—81%

Multiple Cyclones

As gas quantities increase, the logical step is toward multiple cyclones. Many types are manufactured, all operating on the principle that a small cyclone will give high efficiency at lower draft loss. In general, several small cyclones are nested together, each connected to an inlet duct and discharging to a common outlet duct.

Some systems are operated without dampers. In general, where dampers are used for control, either all cyclones work at partial load, or some of the group are shut off and the rest work at nearly full load. Usual control is by a regulator, set for a predetermined draft loss between inlet and outlet. As load varies, the regulator changes inlet dampers to the scrolls, and each cyclone carries part load. Little variation in efficiency occurs, and all cyclones are kept warm, reducing maintenance due to corrosion.

The other system cuts cyclones in and out of service, each operating cyclone working at normal rating. Figs. 17 and 18 show typical examples of multiple cyclones.

A close parallel to the multiple cyclone is the multiple-tube collector, Fig. 19. This unit consists of several horizontal tubes connected to an inlet duct and ending in a gas-discharge chamber. In the inlet of each tube is a bullet-shaped, spirally finned core; at the outlet is a hooded insert. Gas is given a swirling motion as it passes the finned core, and the dust is concentrated in the outer layer of gas. This layer passes out of the tube between hooded insert and inner wall of the tube, while the main body of substantially clean gas passes through the insert to the discharge duct. The dust-laden fraction of the gas passes into a hoppered section from where it is drawn through an auxiliary or secondary cyclone by a fan. This gas is cleaned and returned to the inlet duct, while the dust is discharged through a rotary gate at the cyclone bottom. Draft loss is from 1¼ to 2½ in.

The first installations were made with 15-in. diameter tubes. Since then, a trial installation using 4-in. tubes has shown some increase in efficiency. On a pulverized-fuel boiler, 85% efficiency has been obtained, showing best results with constant-volume recirculation of about 17% of the gas.

Where load variations are severe, the unit is installed in separate sections, one of which can be dampered off at low load. Usually, separate fans and secondary cyclones serve each section.

One English manufacturer has developed a catcher with a scroll of triangular cross-section, Fig. 20. Gas is led through triangular ducts until the dust is concentrated in the apex of the triangle. The triangular top is open at a point over the hoppers. The dust and a fraction of the gas is thrown through this opening by centrifugal

action. The trapped gas then leaks back to the inlet of the scroll. For large gas volumes, scrolls are in multiple.

A Scotch collector of the centrifugal type consists of a circular housing in which vanes trap the dust and lead it to the outside of the housing where it is flung into a discharge duct through a perforated siding, Fig. 21. While both collectors have been advertised and described in periodicals, no test data has been made available.

The compound collector is shown in Fig. 22. Gas is led tangentially into the primary where it is given a centrifugal motion which concentrates the bulk of the dust in a small portion of gas. The main body of gas leaves the primary louvres, while the dust-bearing fraction is skimmed off into a secondary. The secondary consists of a cyclone with skimmer and dust channel to skim the concentrated dust from the gas, and lead it to the bottom of the cyclone. Cleaned gas then passes to the outlet of the primary where it is discharged with the main body of gas. Efficiency of this collector is guaranteed by size as follows:

60 Microns (230 Tyler Mesh)—99%
43 Microns (325 Tyler Mesh)—97%
20 Microns (625 Theor. Mesh)—90%

Draft loss ranges from 1½ in. to 2 in. plus, according to the installation.

Several types of inertia or trap-type collectors are on the market. Fig. 23, Fig. 24 and Fig. 25 are typical.

While details differ, all place in the gas stream a large number of staggered elements. The gas is caused to change direction sharply, and the dust particle, due to its mass and velocity, together with some gas, is thrown through the element opening. Thus the bulk of dust is concentrated in a small fraction of gas.

Elements are open at the bottom, positioned above a hopper into which the dust and gas fraction passes. Dust is thrown downward, while the gas

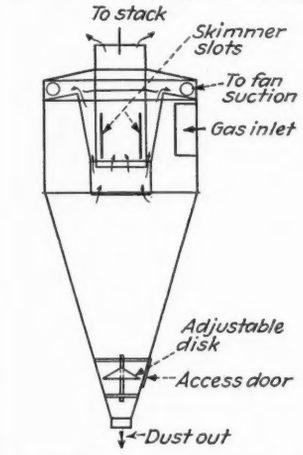


Fig.15-Cyclone with outlet skimmer

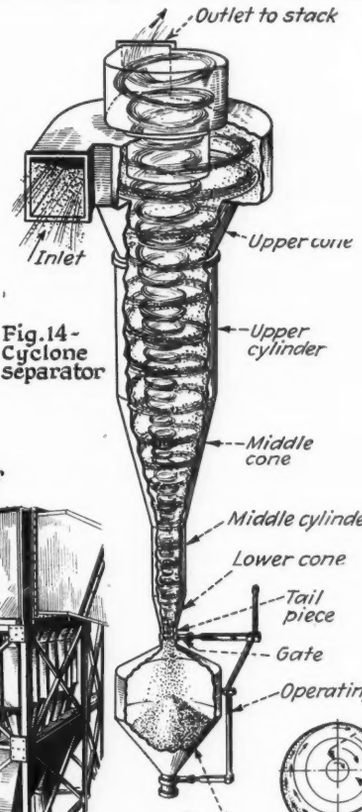


Fig.14-Cyclone separator

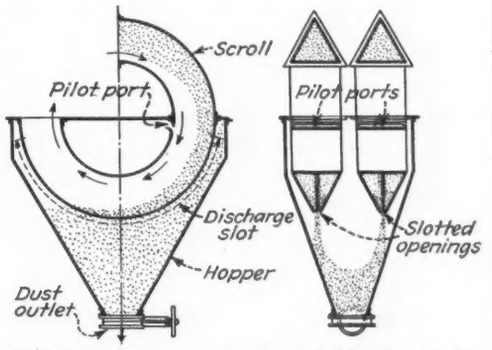


Fig.20-Triangular scroll centrifugal collector

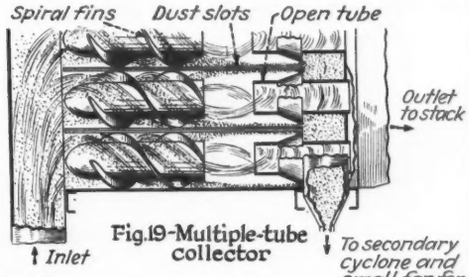


Fig.19-Multiple-tube collector

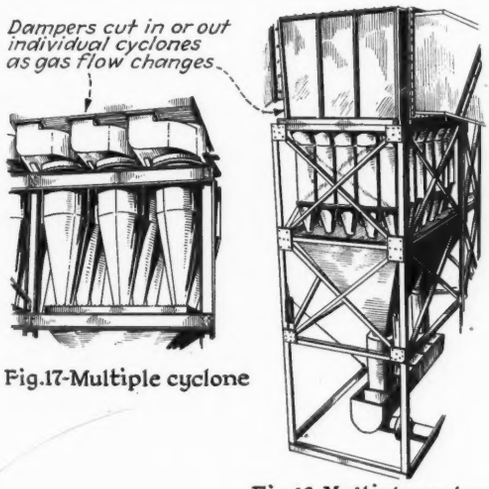
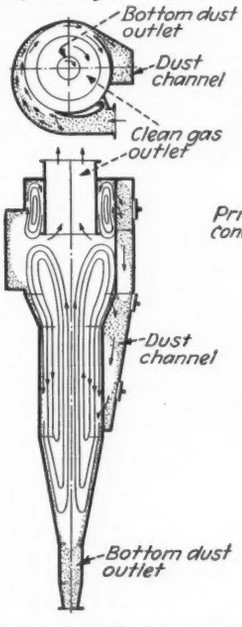


Fig.17-Multiple cyclone

Fig.18-Multiple cyclone with collecting hopper system



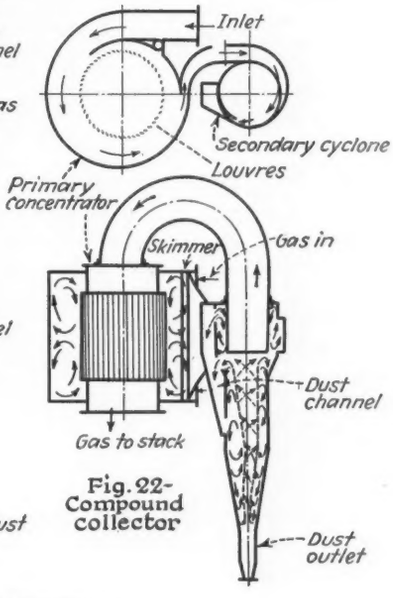


Fig.22-Compound collector

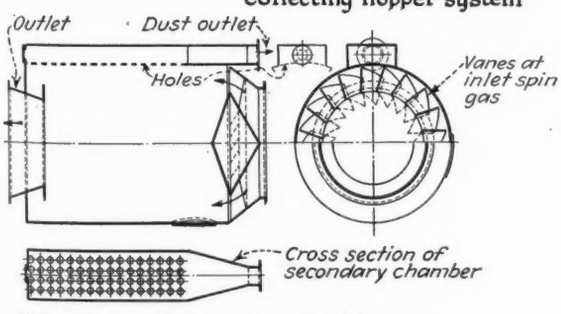


Fig.21-Centrifugal collector with vanes

Fig.16-Cyclone with dust channel

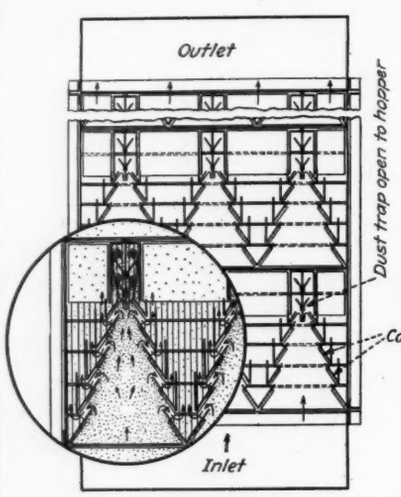


Fig. 23-Cross-section of inertia cinder trap

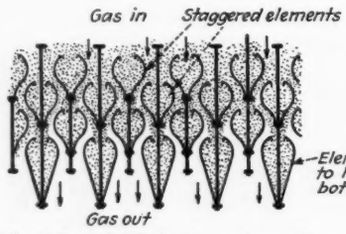


Fig. 24-Inertia-cinder-trap elements

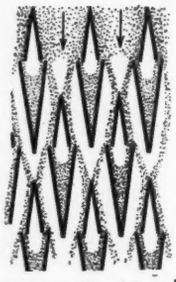


Fig. 25-Inertia skimming elements

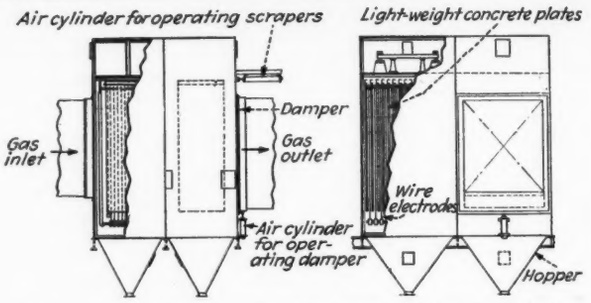


Fig. 27-Concrete-plate electrostatic precipitator

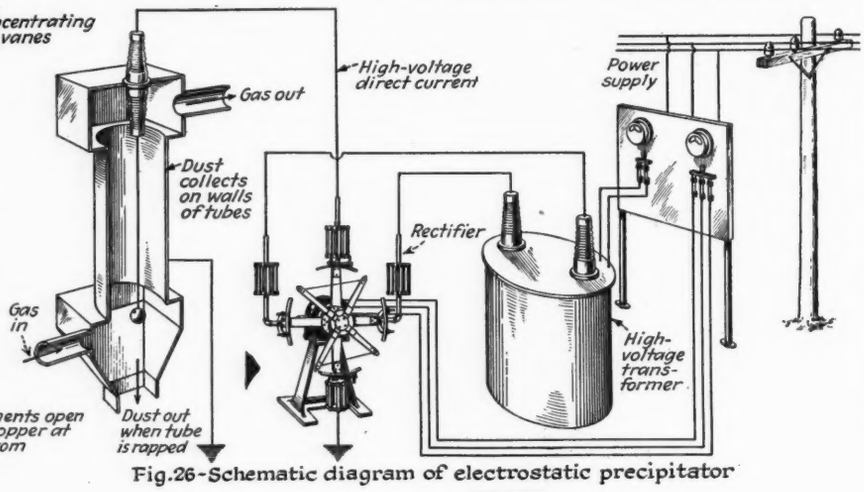


Fig. 26-Schematic diagram of electrostatic precipitator

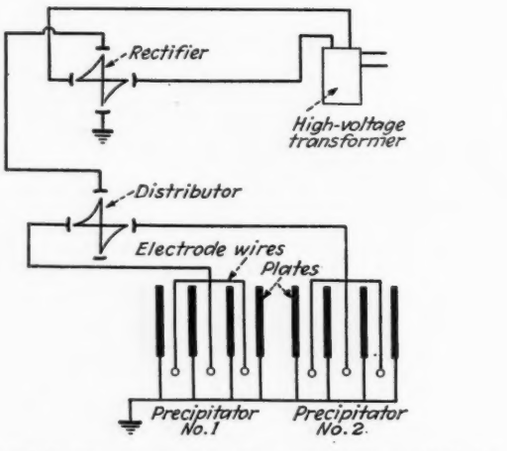


Fig. 28-Half-wave rectifier for electrostatic precipitator

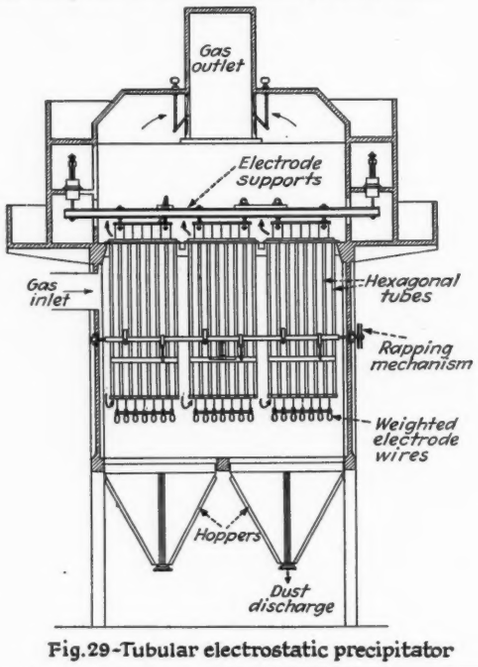


Fig. 29-Tubular electrostatic precipitator

leaks back to join the main gas stream at a point beyond the elements.

Draft loss varies as the number of elements, between ¾ in. and 1¾ in.

Electrostatic Precipitators

High-voltage electric precipitation has been described so often that only a brief description is necessary. It is accomplished by leading flue gas through a number of ducts, in which are hung wire discharge electrodes, the duct wall forming a collecting electrode. A high dc electrical potential is maintained between the electrodes. Dust particles passing through the corona of the discharge electrode become charged and move toward the opposite electrode.

The discharge or wire electrode is negatively charged, using direct current. Due to phenomena of electrical wind and the higher velocity of negative ions and electrons, dust particles are forced toward the positive wall. Schematically, the principle of electrostatic precipitation is shown in Fig. 26.

There are several types of electrical precipitators. The concrete-plate precipitator has been most common in power-plant use, and consists of a series of ducts formed by concrete plates, between which are hung the wire discharge electrodes, Fig. 27. Gas travel is horizontal and dust accumulates on

the plates, from which it is removed periodically by scraper chains, hanging against the plate from a movable head frame. Usually, one section at a time is scraped, and during this period, outlet dampers are closed. Originally, plates were of concrete made of cement, sand and aggregate. Later much lighter Haydite concrete was developed, to reduce over-all weight of the plates.

More recently, for horizontal gas travel, the rod-curtain precipitator was developed to reduce size and weight. In this type, the collecting electrode was a pipe frame with rods forming a curtain inside the frame. While this type had shown good precipitation in metallurgical and chemical fields, it was not completely successful as a fly-ash precipitator. The rods were then covered with perforated steel plate, which increased efficiency. For fly-ash precipitation, therefore, the rod curtain will probably be superseded by steel-plate electrodes. Efficiency can be obtained equal to concrete-plate types; however, the curve is not as smooth, breaking sharply when the design-point gas-velocity has been passed. In the adaptation of this type to power plants, gas volumes in excess of the design quantity require due allowance for the sharp drop in the efficiency curve. A substantial saving in weight, space and cost over the concrete-plate type, is, however, possible.

Where the installation is such that advantage may be taken of vertical gas flow, the vertical-flow, pocket-electrode unit may be used. In this type plate electrodes are separated to form a dead space between. Each electrode plate is so formed that small horizontal outstanding slots substantially cover most of the plate surface. Gas passes vertically and precipitation occurs on the plate surface.

To maintain clean electrodes, this type, like rod-curtain and steel-plate types, the electrode is rapped, rather than scraped. Rapping is continuous or intermittent and is accomplished by an electric motor moving a hammer to strike a sharp blow on the plate frames. In the vertical-flow type, dislodged dust falls but a few inches against the rising gas stream before it drops into the outstanding pockets, and thence into the dead space between electrodes. From there it falls to the hopper bottom below the gas-inlet zone. In these types no dampers are needed to cut off gas flow while rapping. The vertical flow type requires rapping of both electrodes, so as to keep wires free of dust. In the horizontal-flow type, vibration caused by the gas will usually keep discharge electrodes clean.

Electrostatic Efficiency

Electrostatic precipitation takes time; therefore, gas velocity should be low enough to accomplish precipitation before dust is swept through. This feature determines size of precipitator and naturally size increases as higher efficiency is required. Efficiency can be obtained up to 99%+, depending on necessity, with draft loss from ¼ in. to ½ in. Kilowatt input is independent on volume of gas to be treated. Maintenance can be reduced to a minimum by careful selection of equipment.

Lately, half-wave rectification has been advocated and many half-wave installations have been made. In addition, several full-wave installations have been changed over to half wave. Fig. 26 shows a typical arrangement of full-wave precipitation. In half wave, the same arrangement of rectifier phased with the alternating current is used, except that the negative wave is not taken directly to the wire electrodes. Fig. 28 shows diagrammatically the arrangement in which a set of distributing arms are added to the rectifier motor, serving to direct the negative current from one set of electrodes to another. Each set of electrodes is charged alternately, often enough not to affect precipitation efficiency. A dual purpose is served by this arrangement: (1) only one-half as much electrical equipment is needed and (2) arcing is reduced.

Precipitators operate best at a point just below where arcing occurs. Half-wave rectification, by interrupting the charge, allows the potential to dissipate somewhat, reducing the frequency of arcs, and lessening duration and intensity of arch that do occur. With concrete-plate precipitators, this is in line with lower maintenance, as when arcs occur, bits of concrete are spalled from the collecting electrode.

An English precipitator is shown in Fig. 29. All essentials are similar to American types, except the collecting electrodes. These consist of hexagonal, nested tubes, each with a wire electrode hung inside. Tubular electrodes are used in American practice for tar and acid precipitation, where the collected material can flow down the wall of the tube by gravity. With flyash, precipitate has to be rapped loose and gas velocity kept low enough to allow dust to fall against the gas stream without reentrainment. Velocity determines cubic space required which influences weight and cost.

Other types of precipitators on the market here and abroad have about equal efficiency but differ in detail due to patent rights.

Exhaust Lines

By L N ROWLEY

Public utility power plants now require close to 50 million tons of coal annually for their operation, but that amount is only half of what would be needed by equipment of 20 years ago in producing the same amount of electricity, according to W E Blowney, turbine engineer for General Electric.

When you stop over at Alexandria, La., be sure to stay at the air-conditioned Hotel Bentley and be sure to drop down to the model small plant that furnishes all power services for this hotel. Chief Engineer Zoder is particularly proud of the new air-conditioning system and the way the steam-turbine-driven centrifugal compressor fits into the heat balance, using exhaust from the unaflow engines. The 150-ton unit handles load of all public spaces and about half the rooms.

Differences between substitutes and the materials they were designed to replace often intrigue imaginative research men. Right now the fact that balls made of Koroseal look exactly like balls of rubber but don't bounce, has several researchers scratching their heads for some use to which this and other odd properties could be put.

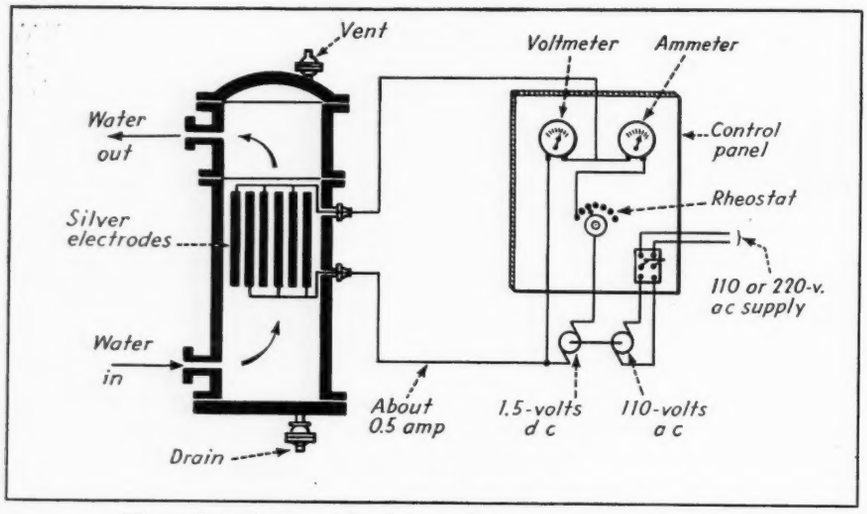
Dropped in for a chat with A B Allen, Chief Engineer of Florida Public Utilities' plant at Fernandina. He's glad to have a new 600-hp diesel to help out the two older units, because load is growing fast. Once center of the shrimp fishing industry of the United States, Fernandina has begun to revive after a period of slow decline. The answer—two new pulp mills; Kraft Corp's sulphate plant and Rayonier's bleached sulphite mill.

Ran into a method of boiler-water treatment at an Oakdale, La., saw mill that used to be more or less common in marine practice. Irish potatoes do the trick. Dumping a bucketful into the drum after washing out the boiler —done about once a month—seems to keep scale from sticking, according to S L Rush, Chief.

Silver-Plated Algae

By JAMES SHEARER
Katadyn Process Corp, New York, N. Y.

Here's a new way to control slime in air-conditioning systems, by bombarding the "bugs" with silver ions



Silver electrodes are placed in makeup or water-supply circuit and a 1.5-volt supply adds 0.08 ppm of silver to kill algae

QUANTITIES OF SILVER too small to be detected by usual chemical analysis control slime and algae in the spray chambers of air conditioners at the Parlin, N. J., plant of the du Pont Film Mfg Corp. Unique among industrial plants in this respect, the algicidal and bactericidal effects of ionic silver have here proved effective during three years of operation.

The silver is dispersed in the cooling water electrically. About half an ampere at 1.5 volts adds 0.08 parts of electrolytic silver to one million parts of water.

Prior to installation of the silver treatment, chlorine had been used but the algae growth (identified as crenothrix) required shutting down the conditioning equipment every week or two to clean plugged spray nozzles and eliminators and to flush walls and floors. On the floors, slime formed at times in white, tree-like masses as high as 3 in. After silver treatment, cleaning periods were extended to over ten weeks.

Well-water supply is given a treatment of sand filtration, soda ash and iron removal before use. A typical raw-water analysis before treatment is:

Iron	0.05 ppm
Carbonates	27.5
Bicarbonates	3.5
Chlorine	7.0
Ammonia (free)	0.002
Loss on ignition	34.0
Oxygen consumed	0.8

Air-Conditioning Units

The air-conditioning units are of the usual spray-chamber type with eliminators and operate 24-hr per day. A typical one handles about 15,000 cfm, which enters the sprays at 95 F and leaves at 60 F. About 25 gpm of 55-F water does the cooling and is then used elsewhere in the plant, not recirculated.

The patented apparatus that introduces the silver is of a standard type used for treatment of drinking water and swimming pools. On its way to the conditioner, water passes between silver electrodes and receives a minute but predetermined amount of silver in the form of positively charged ions. (According to Faraday's law, one ampere-hour would dissolve 4.023 grams of silver, but in commercial apparatus using ordinary water, the yield is only about 2 grams.) The water is unchanged in appearance, taste or odor; but bacteria cannot live in it.

Silver treatment is a development of the discovery in 1893 by Naegeli, a Swiss botanist, that he could not grow algae in water containing traces of certain metals. This property of some metals is known to chemists as the "oligodynamic" effect, meaning the "force of trifles" and refers to the action of extremely minute quantities.

Preliminary Test

At Parlin, a preliminary test showed that the one-to-two week period between cleanings could be extended to at least eight weeks. Even better results have been obtained in normal operation. About 15 man-hr are required for each cleaning.

The primary saving is in reduced costs of cleaning. Operating cost of the silver treatment is almost entirely for the silver used, as the electric current and attention required are negligible.

Enough silver is contained in the apparatus for 25 million gal. of water, about two years' use. This amount of silver costs about $300. Much less silver and a smaller unit would be possible for a recirculating system.

Fewer Shutdown Periods

The operating rooms are now not deprived of air conditioning as often as formerly because of shut down for cleaning, and chlorine treatment has been eliminated. The bacterial quality of the cooled air has, of course, been improved, a feature of the treatment that would be found of value in a hospital or industrial plant where foods are handled.

Preliminary experiments and subsequent operation of the silver treatment were under the direction of D H Kinlock, Plant Manager, and were supervised by C E Rose of the Industrial Engineering Dept.

I THINK *the first virtue is to restrain the tongue; he approaches nearest to the gods who knows how to be silent, even though he is in the right.*—Cato

TO BE *seventy years young is sometimes far more cheerful and hopeful than to be forty years old.*—Oliver Wendell Holmes

Why and How of Escalators

In recent years, a convenience-conscious public has demanded increasing use of escalators. Here is a review of modern practice, slanted for operating and building engineers

VERTICAL TRANSPORTATION of people in buildings and other public places has become one of our major problems, because of higher buildings and people who are more convenience conscious than they used to be. Where a few years ago apartment-house tenants did not object to walking up 4 or 5 flights of stairs, today one flight might be objectionable. Out of this has grown a need for more and better means of low-rise vertical transportation to handle large crowds in department stores, theatres, railway terminals, subway and elevated railway stations, factories and other public places. In these services, escalators are being used in large numbers.

For handling large crowds, escalators have many advantages, the first being their large capacity. A single escalator 4 ft wide will handle up to 8000 passengers per hour, where a large low-rise elevator is limited to about 500. An escalator handles as many passengers on a 70-ft rise as a 12-ft one. With an elevator, height of rise is a limiting factor in determining the number of passengers handled in a given time. But an escalator loses no time in loading, starting, stopping and unloading, and the inconvenience of crowding in and out is eliminated. You can step upon an escalator at any time and be carried up or down at a moderate rate of speed, comfortably, safely and without physical effort, other than walking on and off. No operator is required and power consumption is low.

Escalators are not limited to handling large crowds. Frequently, they are installed for inter-office service where a company occupies more than one floor. Escalators connecting ground to the second floor of an office building make the latter almost as desirable for renting as the former.

These and many other factors have made escalators almost as popular as elevators for low- and medium-rise service. They have the disadvantage of being limited in the rise for which they can be built, but gradually this limit is being increased. Two Otis escalators in the Lexington Ave and 53rd St station of the Independent Subway, New York, N. Y., have a vertical lift of 56 ft. On the subway system in London, England, there are 18 escalators serving vertical rises of 58 to 81 ft. Some of these escalators have capacities up to 16,000 passengers per hr and operate at speeds up to 180 fpm. Speed of escalators in the United States has been limited to 90 ft per min, run at a standard angle of 30 deg to the horizontal. Standard widths are 2, 3 or 4 ft.

Escalators in Series

Even though escalators are limited in the height of a single rise for which they can be built, they can be operated in series to serve several floors. This is frequently done in large department stores. Operation in this manner requires a transfer at each floor, but this isn't a serious objection in department stores, as a large part of the traffic is from floor to floor. Escalators can be operated ascending or descending or can be installed to operate in either direction. For example, they can ascend for part of the day and run descending at other times.

Two types of escalators are used in passenger service. The flat-step type, with smooth treads, Fig. 1, requires a shunt *S* at the landings to guide passengers off. This type of step appears from under the floor at the lower landing as a moving platform.

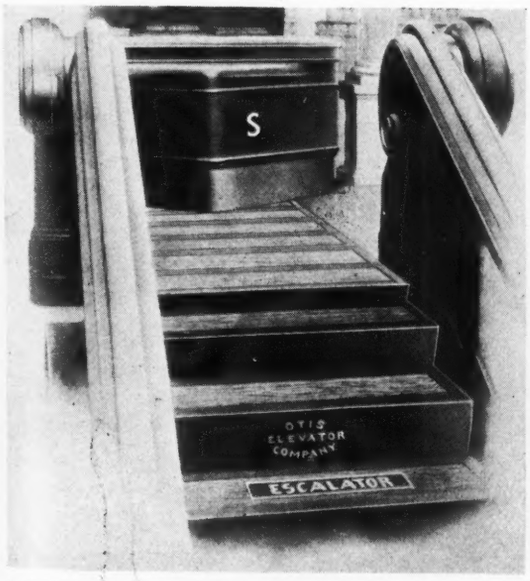


Fig. 1—Flat-step escalator requires a shunt S at the unloading end. Fig. 2—Cleat-step escalators have superseded the flat-step type

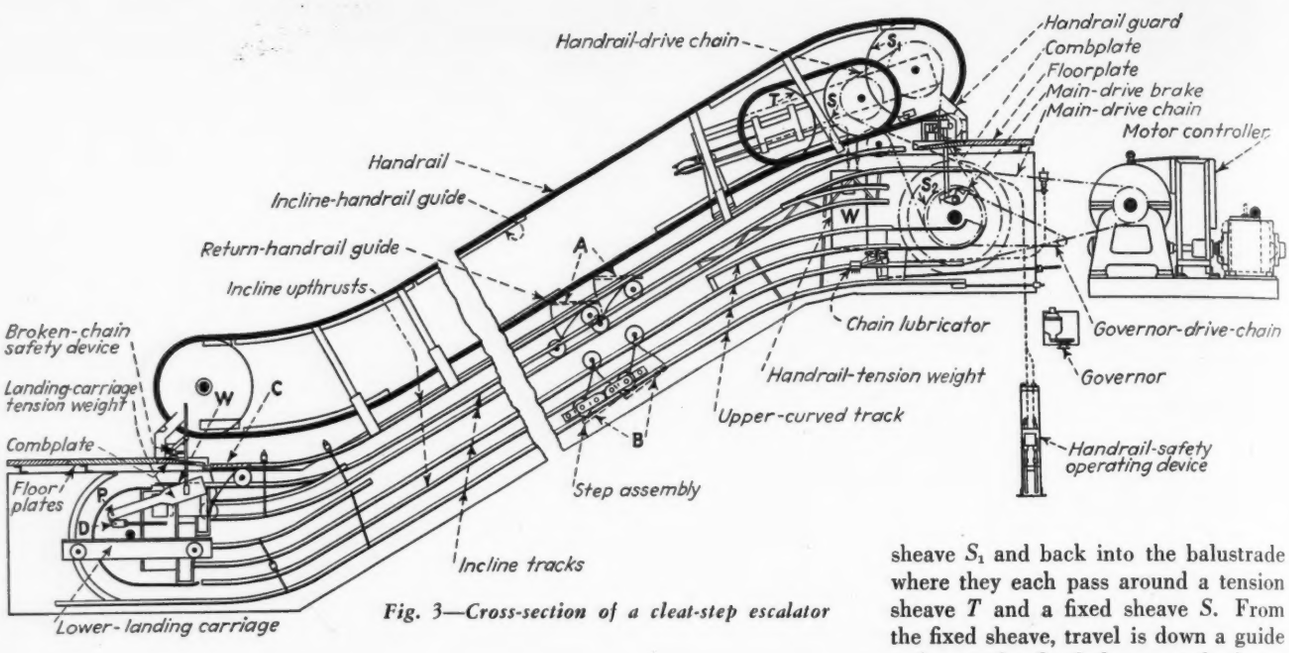


Fig. 3—Cross-section of a cleat-step escalator

As it goes upward it slowly breaks into a flight of steps rising into a complete stairway. On each side, a handrail of flexible material moves forward at the same speed as the stairs, affording passengers a secure support, if they care to use it, as they ascend or descend. At the top, the stairs again flatten out into a moving platform, from which the passengers step to the stationary landing on the same level. This type has been built to operate either ascending or descending; for ascending escalators, the shunt is placed at the upper landing and for descending operation, the shunt is at the lower landing.

Flat-step escalators are no longer built, being superseded by the cleat-step type, Fig. 2. This type is of the same general construction as the flat-step design, but has cleats fastened crosswise on its steps. The cleats permit use of a comb-type landing, Fig. 6, making it possible to install the escalator practically within the length of its balustrade and eliminating landing shunts required on the flat-step type. At the loading and landing ends, cleats on the steps run between the comb teeth to make getting on and off the escalator easy and safe. Steps and landing of modern escalators operate with very close clearances; it is almost impossible to get even small objects caught in them.

An escalator is in reality a highly refined conveyor. It comprises three main parts, the two traveling handrails, the traveling stairway and the driving machine. Fig. 3 shows these parts for an Otis escalator in their correct relation to each other. The traveling handrails are rubber belts of special cross-section that travel on a guide on top of the balustrades. At the top end of travel they pass down over a sheave S_1 and back into the balustrade where they each pass around a tension sheave T and a fixed sheave S. From the fixed sheave, travel is down a guide and around a fixed sheave at the lower end of the escalator.

Each tension sheave is mounted on a guided frame and connected by a wire rope that passes over two small sheaves to a weight W. This weight maintains correct tension in the traveling handrail by taking out slack due to stretch or any other cause. A limit switch opened by the weight stops the escalator if handrail becomes slack. To drive the traveling handrail, a chain drive connects a sprocket on the shafts of fixed sheaves S and S_1 with a sprocket S_2 on the main drive shaft.

Escalator steps are constructed as in Fig. 4 and are carried on two chain drives, section of which is shown in Fig. 5. Inside edge of each step connects at A to the shaft, running through two chain strands. Each end of these shafts is supported in a wheel that runs on a track. On the riser side, the steps are supported on a shaft and two

Fig. 4—Escalator step of the cleat design

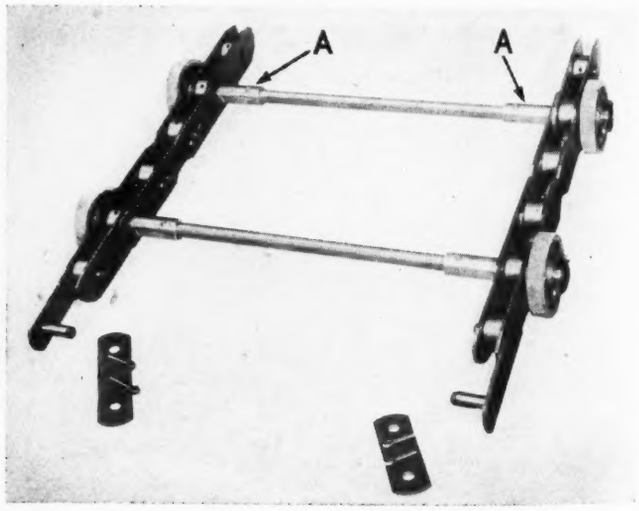


Fig. 5—Section of step-drive chains

wheels, so that each end of a step runs on two wheels on a track as at *A*, Fig. 3. The wheels on the shafts passing through the chain also support the chain, in a way that both chain and steps are carried clear of all stationary parts, insuring quiet operation. A rail above the wheels that carry the chain prevents up-thrust of the chain and holds the steps in perfect alignment at all times.

Chain Drives

At each end of the escalator the step-drive chains run on sprocket wheels, those for the upper end being shown at *D*, Fig. 7. Driving the escalator is always done from the upper end as in Fig. 3. In Fig. 7 are shown the power application sprockets *P*, the handrail drive-sprockets *H*, one for each handrail and the speed-governor drive-sprocket *G*. A brake is provided between *P* and *D* to hold the escalator from running free when power is off the drive motor.

At the top, the escalator step-wheels are guided by rails around the sprockets so that the steps follow quietly around with their chains. On the return incline the steps take a position between the guide rails as at *B*. To take care of the incline upthrust of the chain, its wheels run between rails as on the top strand. At the lower end, the step- and chain-wheels are guided in curved tracks without sprockets so that the steps follow around as at the top end. At the lower landing, as the steps come around the track carriage, they run horizontally for a short distance, as at *C*, and gradually rise to the full height of their tread as at *A*, when they come onto the incline.

At the lower end of the escalator, carriage and tracks are mounted on guide wheels carried on a short horizontal track so that the carriage can move to keep proper tension in the chain. This tension is maintained by weighted arm *W*, pivoted at *P*, and connected to the carriage carrier at *D* by a bell crank. Any lengthening of the chain because of wear is taken up automatically by the weight moving downward and moving carriage carrier outward. Movement of the carrier is limited to about 1.25 in., when a switch opens and stops the driving motor. This switch also acts as a broken-chain safety-device to stop the escalator in case the chain breaks.

Escalators are driven by constant-speed motors, the drive unit comprising a motor and worm gear. The gear shaft connects to the escalator drive shaft by a 2- or 3-strand roller chain, depending upon power transmitted. Where direct current is available, a simple shunt motor is used. For alternating-current, the motor is a squirrel-cage single-speed unit for small escalators, and 2-speed type for large ones.

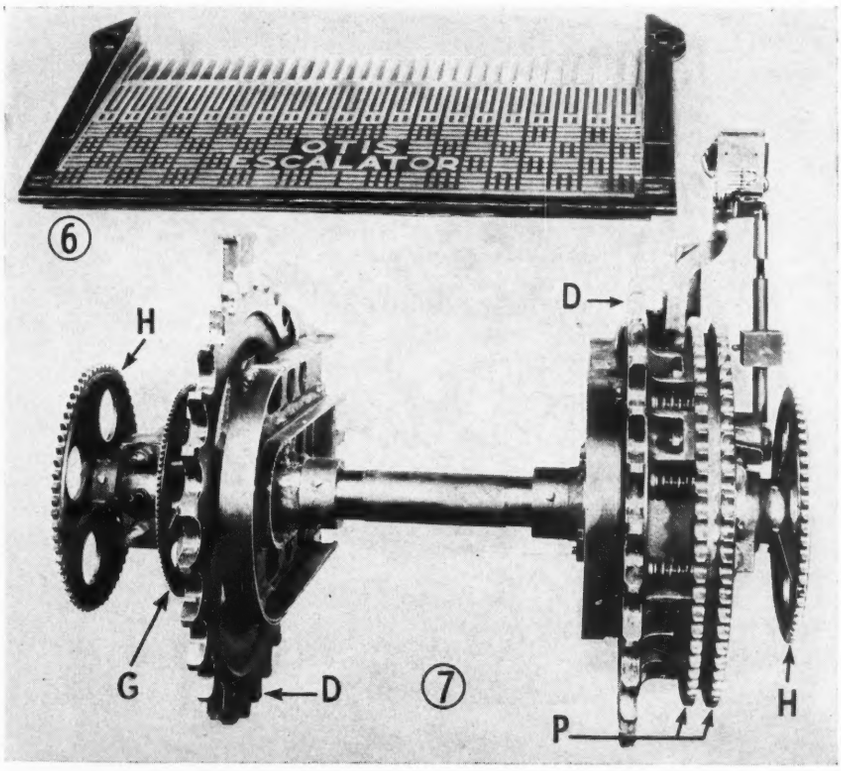


Fig. 6—Comb-type landing for cleat-step escalator. Modern designs have comb teeth more closely spaced than shown here. Fig. 7—Drive shaft of a cleat-step escalator, showing power-chain sprockets P, step-chain-drive sprockets D, hand-rail-drive sprockets H, and speed-governor-drive sprocket G

Though escalators are subjected to all the pranks that human ingenuity, curiosity, and carelessness can devise, they are today's safest method of transportation. They are made safe for even the most careless people to ride on. This is done by making all moving clearances very small and arranging the loading and discharge ends so that it is almost impossible to get on or off the escalator improperly.

Beyond these safety features incorporated as a part of the escalator is a second line of defense to prevent hazards from operation, some of which have already been mentioned. These include a safety brake on the main drive shaft that sets and holds the escalator when power is cut out of the motor. This feature is very important on a heavily loaded, ascending escalator. If the power were cut off the motor, the escalator might otherwise run backward and pile up the passengers at the lower landing. This cannot happen, however, because the instant that power fails, the brake applies. Escalators that operate in the ascending direction only also have a non-reversing safety device that prevents reverse running under any condition.

Safety Devices

If either one or both step-drive chains break, power will be cut out of the motor and the safety brake applied. If someone were to pull the handrail off its guide, or the handrail were to break for any reason, the broken handrail safety device would function to stop the motor and apply the safety brake. An overspeed governor opens a switch that cuts power off the motor and applies the safety brake if the escalator overspeeds from any cause.

In addition to the safety devices on the escalators, the motor control is provided with a low-voltage relay that cuts power out of the motor if the voltage drops below a predetermined value. Overload relays protect the motor against overloads, and reverse-phase relays on ac prevent the motor being reversed by crossing the power leads outside the motor room. At the top and bottom landings, emergency buttons are provided. If either of these buttons is pressed, the escalator will stop immediately. In New York City subway service, an emergency button is also provided in the ticket booth nearest the escalator so that the attendant can stop the escalator if necessary.

Speaking of Power

First on my program is my monthly ballyhoo—and we've really got something worth ballyhooing. I refer to The Operating Engineer (page 93), now in its second month. As George Edwards told you in June, "it's your baby", if you are an operating man, as most readers are. . . . It's a regular 16-page magazine within a magazine, tailored to fit the needs of operators, with plenty of attention to problems of small industrial, building and institutional plants.

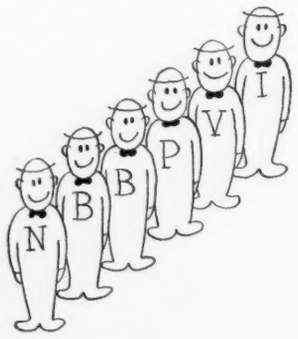
It's your baby . . .

. . . George Edwards is the Advisory Editor; he's the man who is going to see that this section stays *Practical* from start to finish. But it's up to you to give us a tip now and then, so put on your specs and give this section the works. Then tell me, or George, what you like and what you don't like about The Operating Engineer.

But don't get the idea that we're going to forget the rest of the book. Here are a few highlights from this number. Ruppert's Brewery, page 58, is a swell example of how to save power dollars by combining modern equipment with smart operation. Formerly, Rupperts generated steam at 125 lb and used a lot of it directly in process; now it's generated at 400 lb and bled from turbines for process with practically no steam to condensers. Savings are plenty. . . . You hear a lot about dust collection. Taken together, last month's installment and this month's (page 64) make practically a special section on the subject —a boiled-down handbook, with lots of drawings.

Flat leather belts are old stuff—your grandfather "knew all about them," but there are some new standards still unknown to most belt users. Turn to tables and information beginning on the facing page—and learn to figure flat leather-belt capacities. . . . To project your mind beyond the local horizon, you might like to read (page 78) how European designers are cutting down the weight per horsepower of steam engines and turbines—a relief from what you hear about Europe in the newspapers.

As usual, the National Board of Boiler and Pressure Vessel Inspectors held its annual meeting in May at the Hotel McAlpin, in New York—a fine bunch of real power men from all over the U. S. . . . Which reminds me that Dr. Jacobus (B & W) speaking there for



Real power men . . .

the Boiler Code, which these inspectors enforce, referred gratefully to the work of the late Fred Low on the Code Committee. For the benefit of Fred's many friends and admirers, I quote:

"Fred Low, the second chairman of the Committee, was beloved by all on account of his kindliness and keen insight into human nature which, coupled with his sound engineering judgment, made him an ideal guide for the Committee. Throughout his illness, he asked many times about the doings of the Committee and in his last spell of consciousness a day or so before he died, he requested me to remember him to the boys on the Committee, who he said were a 'great bunch'."

Since we're always giving other people advice, it's good for us to take our own medicine now and then. As a matter of fact, we do constantly in-

Take our own medicine . . .

vite reader suggestions for improving *Power*. Naturally, we can't follow them all, but we do consider them carefully and get a lot of worth-while tips. Now and then we blush a bit for not seeing something that was right under our nose. A reader asked, "Why not put the page number of the table of contents on the cover?" Apologies, it's done.

A friend working for a manufacturer of power equipment writes me, "nothing annoys the reputable manufacturer more than to see a customer purchase equipment strictly on a price basis and then, through lack of suitable records, never discover that he has been short-

Pays to keep records . . .

changed." Fair enough; you never know what anything costs you if you only know what you paid for it. . . . Right now I'm limping along with a bargain lawn mower I bought two years ago. Even without a cost system, I'm getting wise to the fact that I can't afford to run it much longer and must soon sell it for salvage and buy the good one I should have bought in the first place. . . . On big power equipment, where real money is involved, it pays to keep records of labor, fuel, supplies and maintenance to add to your fixed charges to see what it really costs you to own the contraption. . . . But don't get me wrong; I'm not one of those who thinks it always pays to buy the most costly article. Chase your bargains, by all means, but look at their teeth before you buy.

West coast jaunt . . .

I am writing this page in New York. By the time it reaches you, I expect to be in Los Angeles or San Francisco. The story of this West Coast jaunt will appear in August *Power*, and in September.—PHIL SWAIN, Editor.

A New Yardstick for Selecting Leather Belts

By L H SKOUGOR
Research Engineer
American Leather Belting Association

Examples show how to use the new American Leather Belting Assn standards for selecting flat-leather belts

A LONG-FELT NEED for standards of leather-belt applications has been met by a set of horsepower-rating tables published recently by the American Leather Belting Assn, New York, N. Y. Previous publications did not always agree on what was good belting practice, causing considerable confusion in the industry. These new tables, made available as the recommended standards of the leather-belting industry's recognized authority, make it possible for the designer and purchaser to draw up his own specifications rather than rely upon competing individuals.

Table I lists horsepower-transmission capacities for 1-in. leather belts at different speeds with the same size pulleys. These do not represent peak-load ratings, but are based on proper tensions and factors of safety, so that when corrected by the factors in Tables II and III, a conservatively designed drive is obtained to meet requirements of different industries. Table IV gives thickness specifications for flat leather belting approved and adopted by the American Leather Belting Assn.

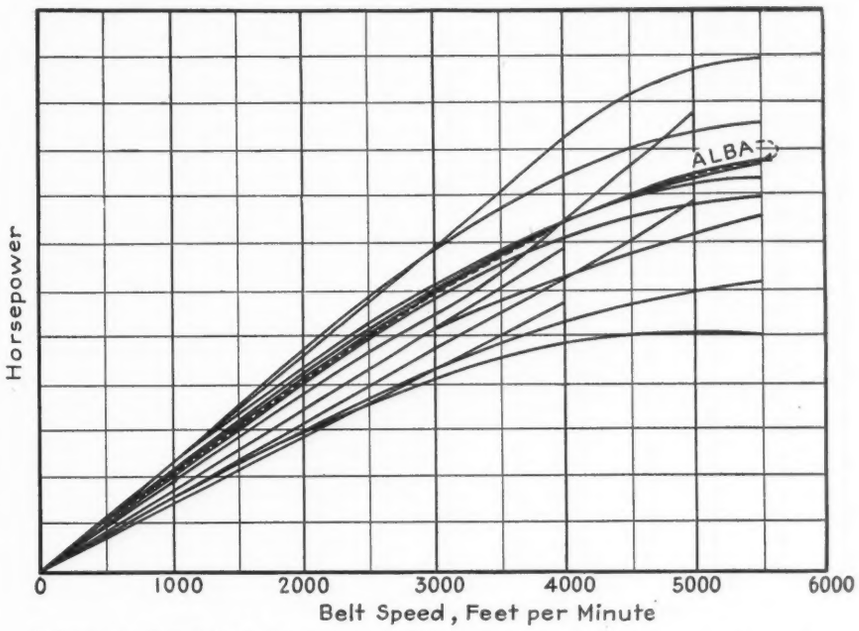


Fig. 1—Leather-belting hp curves plotted from data taken from several sources

In Fig. 1 are plotted the leather-belting horsepower curves from practically all manufacturers and authorities. The curve based on Table I of the American Leather Belting Assn falls as a fair average of the others. When correction factors, Tables II and III, are applied, the ALBA curve will probably fall below those now below it.

Now let's consider the tables in more detail. Table I gives normal horsepower ratings of different weights of flat leather belting at given belt speeds. Across the bottom of the table are minimum pulley diameters for different weights of belt; across the top of the table, belt thicknesses. For example, select double-medium and fol-

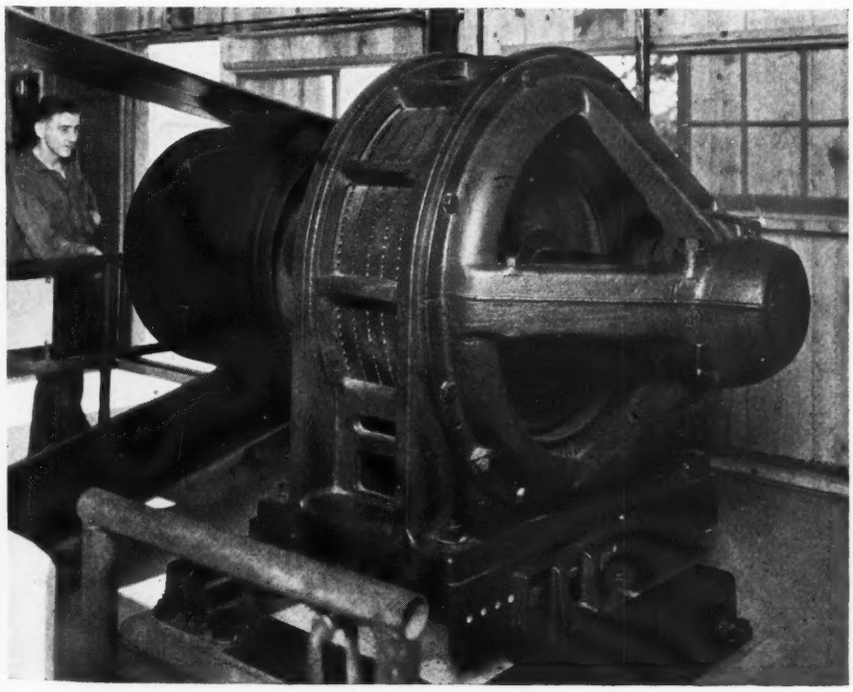


Fig. 2—A 200-hp, 600-rpm squirrel-cage induction motor connected to air compressor by 24-in. belt running on 25-in. and 72-in. pulleys

low down to the bottom of the column. For belts under 8 in. wide we find a minimum pulley diameter of 8 in. is permitted. For belts of this weight, 8 in. wide and over, pulley diameter should not be less than 10 in.

Values in the center of Table I are horsepower per inch of belt width, at different speeds, in feet per minute. At 3000 fpm, given in the first column on the left, a heavy single belt will be good for 5.9 hp, a medium-double belt, 8.7 hp, and a triple-medium 11.6 hp per in. of width.

Across the top of Table II are distances in feet between shaft centers, on which the pulleys are installed. Below each value of center distance are two columns headed "Tight Side Above" and "Tight Side Below." Values in the columns below these headings take into account effects of arc of belt contact, on the smaller pulley, on the horsepower capacity of the belt.

For example, a 10-in. pulley at 1750 rpm will give a belt speed of about 4600 fpm. At this speed a light-double belt, in Table I, has a rating of 9.8 hp per in. of width. Assume 8-ft distance between shaft centers. Starting on the left of Table II, with a 10-in. pulley, following to the right to the two columns headed 8-ft center distance, we find the factor 0.71 to be applied when the tight side of the belt is on top and 0.74 when the tight side is below.

If the belt previously selected is to operate with the tight side on top, then it has a rating of only $9.8 \times 0.71 = 7$ hp and $9.8 \times 0.74 = 7.25$ hp if its tight side is on the bottom. These values represent belt capacity without taking into account the factors in Table III, which include atmospheric conditions, angle that the center-distance line makes with the horizontal, pulley material, kind of service and peak-load conditions. In all of these, with the exception of "Peak Loads," there is a normal condition for which no correction is made, the factor being 1.

To apply the tables to an actual problem, assume a belt coal conveyor driven by a 50-hp, 1150-rpm wound-rotor motor. Temperatures may be low, so starting at times is difficult. Because of coal dust, moisture and dirt, atmospheric conditions are bad. The motor is to be mounted on a pivoted base with the tight side of the belt next to the pivot point. Motor is located with respect to the driven shaft so that center distance between motor

TABLE I — HP PER IN. OF WIDTH FOR OAK-TANNED FLAT LEATHER BELTS*

BELT SPEED, fpm	SINGLE PLY 11/64 in. Medium	SINGLE PLY 13/64 in. Heavy	DOUBLE PLY 18/64 in. Light	DOUBLE PLY 20/64 in. Medium	DOUBLE PLY 23/64 in. Heavy	TRIPLE PLY 30/64 in. Medium	TRIPLE PLY 34/64 in. Heavy	BELT SPEED, fpm	SINGLE PLY 11/64 in. Medium	SINGLE PLY 13/64 in. Heavy	DOUBLE PLY 18/64in. Light	DOUBLE PLY 20/64 in. Medium	DOUBLE PLY 23/64 in. Heavy	TRIPLE PLY 30/64 in. Medium	TRIPLE PLY 34/64 in. Heavy
600	1.1	1.2	1.5	1.8	2.2	2.5	2.8	3400	5.7	6.6	7.9	9.7	11.2	12.9	14.2
800	1.4	1.7	2.0	2.4	2.9	3.3	3.6	3600	5.9	6.9	8.3	10.1	11.7	13.4	14.8
1000	1.8	2.1	2.6	3.1	3.6	4.1	4.5	3800	6.2	7.1	8.7	10.5	12.2	14.0	15.4
1200	2.1	2.5	3.1	3.7	4.3	4.9	5.4	4000	6.4	7.4	9.0	10.9	12.6	14.5	16.0
1400	2.5	2.9	3.5	4.3	4.9	5.7	6.3	4200	6.7	7.7	9.3	11.3	13.0	15.0	16.5
1600	2.8	3.3	4.0	4.9	5.6	6.5	7.1	4400	6.9	7.9	9.6	11.7	13.4	15.4	16.9
1800	3.2	3.7	4.5	5.4	6.2	7.3	8.0	4600	7.1	8.1	9.8	12.0	13.8	15.8	17.4
2000	3.5	4.1	4.9	6.0	6.9	8.1	8.9	4800	7.2	8.3	10.1	12.3	14.1	16.2	17.8
2200	3.9	4.5	5.4	6.6	7.6	8.8	9.7	5000	7.4	8.4	10.3	12.5	14.3	16.5	18.2
2400	4.2	4.9	5.9	7.1	8.2	9.5	10.4	5200	7.5	8.6	10.5	12.8	14.6	16.8	18.5
2600	4.5	5.3	6.3	7.7	8.9	10.3	11.0	5400	7.6	8.7	10.6	12.9	14.8	17.1	18.8
2800	4.9	5.6	6.8	8.2	9.5	11.0	12.1	5600	7.7	8.8	10.8	13.1	15.0	17.3	19.0
3000	5.2	5.9	7.2	8.7	10.0	11.6	12.8	5800	7.7	8.9	10.9	13.2	15.1	17.5	19.2
3200	5.4	6.3	7.6	9.2	10.6	12.3	13.5	6000	7.8	8.9	10.9	13.2	15.2	17.6	19.3
Minimum Pulley Diameters in In. — Belts under 8 in. wide	3	5	6	8	12	20	24	....	3	5	6	8	12	20	24
Minimum Pulley Diameters in In. — Belts 8 in. & over wide	5	7	8	10	14	24	30	....	5	7	8	10	14	24	30

* For belt speeds of over 6000 fpm consult a leather-belting manufacturer.

TABLE II — CORRECTION FACTOR FOR CENTER DISTANCE AND SMALL PULLEY DIAMETER *

Diameter small pulley, inches	Center Distance in Feet: Up to 4		6		8		10		12		15		20		25 & over	
	Tight Side Above	Tight Side Below	Tight Side Above	Tight Side Below	Tight Side Above	Tight Side Below	Tight Side Above	Tight Side Below	Tight Side Above	Tight Side Below	Tight Side Above	Tight Side Below	Tight Side Above	Tight Side Below	Tight Side Above	Tight Side Below
3	0.45	0.45	0.46	0.47	0.47	0.48	0.47	0.49	0.48	0.50	0.49	0.52	0.48	0.54	0.48	0.55
4	0.53	0.53	0.54	0.55	0.55	0.57	0.56	0.59	0.57	0.61	0.58	0.63	0.59	0.65	0.59	0.66
5	0.59	0.59	0.60	0.62	0.62	0.64	0.63	0.66	0.63	0.68	0.65	0.70	0.66	0.72	0.66	0.74
6	0.62	0.62	0.63	0.65	0.65	0.68	0.66	0.70	0.67	0.72	0.68	0.74	0.69	0.76	0.70	0.78
8	0.66	0.66	0.67	0.69	0.69	0.72	0.70	0.74	0.71	0.76	0.72	0.78	0.73	0.80	0.74	0.82
10	0.68	0.68	0.70	0.71	0.71	0.74	0.73	0.77	0.73	0.79	0.75	0.81	0.76	0.83	0.77	0.85
12	0.70	0.70	0.72	0.74	0.73	0.77	0.75	0.79	0.76	0.81	0.77	0.83	0.78	0.86	0.79	0.88
15	0.73	0.73	0.74	0.76	0.76	0.79	0.77	0.82	0.78	0.84	0.80	0.86	0.81	0.89	0.82	0.91
18	0.75	0.75	0.76	0.78	0.78	0.81	0.79	0.84	0.80	0.86	0.82	0.89	0.83	0.91	0.84	0.93
24	0.77	0.77	0.79	0.81	0.81	0.84	0.82	0.87	0.83	0.89	0.85	0.92	0.86	0.94	0.87	0.96
30	0.79	0.79	0.81	0.82	0.82	0.86	0.84	0.89	0.85	0.91	0.87	0.94	0.88	0.96	0.89	0.98
36	0.80	0.80	0.83	0.84	0.83	0.87	0.85	0.90	0.86	0.92	0.88	0.95	0.89	0.98	0.90	1.00

* Consider gravity idler and pivoted-motor drives with tight side of the belt next to the pivot point as having 25-ft centers. For pivot-base drives where tight side of belt is away from the pivot point, do not use these tables; consult a belting manufacturer.

and driven shafts is 10 ft, with the center line making an angle of 65 deg with horizontal. The motor is to have a 14-in. fiber pulley to drive onto a 42-in. one on the conveyor.

A 14-in. pulley at 1150 rpm gives a belt speed of $14\times3.14\times1150\div12=4215$ fpm. This pulley will permit using a heavy-double belt (Table I). Since the belt speed is fairly high, let's try a medium-double belt, because a thin belt is better than a thick one if it will do the job without excessive width. Again from Table I, we find that at 4200 fpm, this belt will transmit 11.3 hp per in. of width. The motor is to operate on a pivoted base, with the tight side of the belt next to the pivot. This, according to the footnote on Table II, may be considered as a belt operating on a 25-ft center distance, factors for which are found in the right-hand column of Table II. A correction factor as obtained from this table is 0.91—take 0.9 for a 14-in. pulley.

Atmospheric conditions are bad, so from Table III we will use the correction factor 0.7. Centerline of the drive makes a 65-deg angle with horizontal; therefore, the correction factor used for this condition is 0.9, Table III. A fiber pulley is used, which permits the belt to transmit more power with the same tension than when running on a steel pulley, so that here we increase the belt rating by using a correction factor of 1.2.

Service Conditions

Table III presents three service conditions. A coal conveyor operates intermittently, but it is an important service, and is required to operate part of each day. Here, it's a matter of judgment and personal opinion as to what factor to select; normal, which is 1.0, is satisfactory.

As to load conditions, normally they will be fairly steady, if the conveyor is well maintained and runs on antifriction bearings. If the conveyor runs on sleeve bearings and is not well maintained, or if it's allowed to stand loaded through a cold night, starting loads will be severe and the correction factor of 0.6 should be used. We will assume that the conveyor is operated under reasonably favorable conditions for such equipment and so we select a correction factor of 0.8. A wound-rotor motor, even though it can develop a high starting torque, because its torque can be controlled, does not impose as severe starting conditions as across-the-line-start squirrel-cage motors, torque of which cannot be controlled.

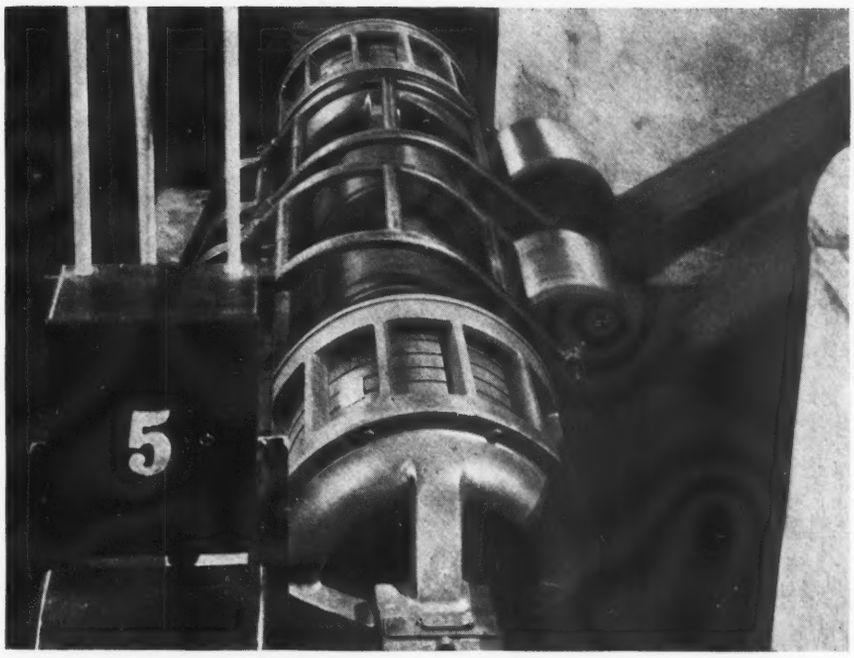


Fig. 3—Two 75-hp synchronous motors driving paper-mill beaters through flat belts

TABLE III—SERVICE CORRECTION FACTORS TO USE WITH VALUES IN TABLES I AND II

		Factor
Atmospheric Condition	Clean, scheduled maintenance	1.2
	Normal	1.0
	Oily, wet or dusty	0.7
Angle of Center Line	Horizontal to 60 deg from horizontal	1.0
	60 to 75 deg from horizontal	0.9
	75 to 90 deg from horizontal	0.8
Pulley Material	Fiber on motor and small pulleys	1.2
	Cast iron or steel	1.0
Service	Temporary or intermittent	1.2
	Normal	1.0
	Important or continuous	0.8
Peak Loads	Light, steady load such as: Steam engines, steam turbines, diesels, and multi-cylinder gasoline engines	1.0
	Jerkey loads, reciprocating machines such as: Normal-starting-torque squirrel-cage motors, shunt-wound dc motors, and single-cylinder gasoline engines	0.8
	Shock and reversing loads, full-voltage start such as: Squirrel-cage and synchronous motors	0.6

TABLE IV—THICKNESS SPECIFICATIONS FOR FLAT LEATHER BELTING, APPROVED AND ADOPTED BY AMERICAN LEATHER BELTING ASSN.

Medium, single-ply—11/64 in. average
Heavy, single-ply—13/64 in. average

Light, double ply—18/64 in. average
Medium, double ply—20/64 in. average
Heavy, double ply—23/64 in. average

****Medium, triple ply—30/64 in. average***
****Heavy, triple ply—34/64 in. average***

****TRIPLE PLY: These are averages for general usage. Most triple-ply belts are usually constructed for particular drive conditions. Tolerances for single- and double-ply belts do not apply. Consult a leather-belting manufacturer for specific information concerning thickness and construction of 3-ply belts.***

All thicknesses in this table are average thickness in inches, and should be determined by measuring 20 coils and dividing this total by the number of coils measured. In rolls of belting containing less than 20 coils, the average thickness should be determined by measuring all the coils in the roll. Allowable tolerances for all thicknesses plus or minus 1/64th in. from above averages.

Uniformity: No point in single belting shall be more than 3/64 in. thicker or more than 2/64 in. thinner than the average thickness. With doubles, the tolerances shall be 2/64 in. thicker or thinner than the average.

Now we determine the width of the belt, which is equal to motor horsepower, 50, divided by (horsepower per in. of belt width times the correction factors). Then, "Belt Width $= 50\div(11.3\times0.9\times0.7\times0.9\times1.2\times1\times0.8) = 8.15$ in.—say 8.5 in. This belt will operate on a pulley 9 in. wide.

Lubrication by Circulation

Gravity and force-feed circulating systems are widely used; here's how they work, where and why each has its particular applications

By JAMES I CLOWER
Associate Professor of Machine Design
Virginia Polytechnic Institute

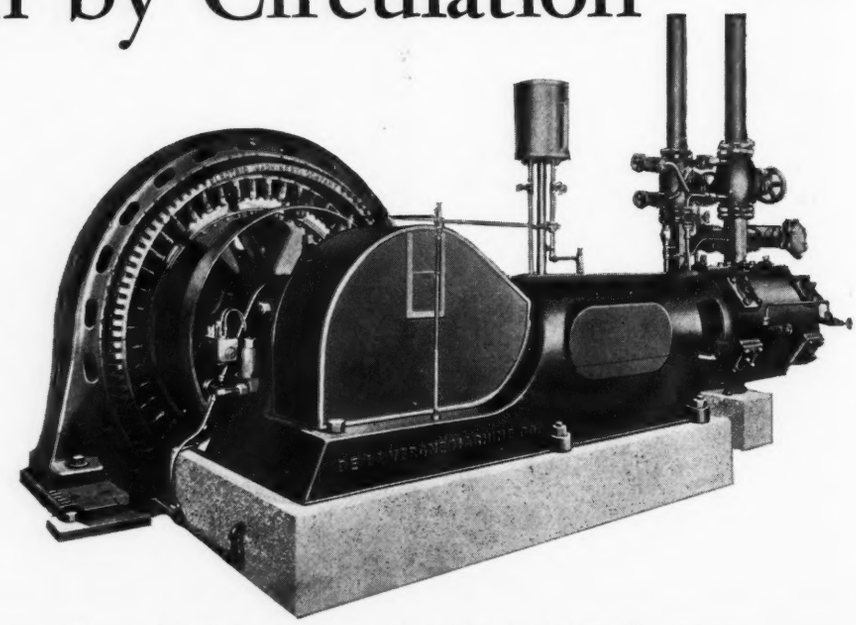


Fig. 1—Ammonia compressor with gravity circulating oiling system

CIRCULATING OILING SYSTEMS are today widely used on steam and other engines, steam turbines, compressors and many other machines. This article considers the various types and variations, and the particular applications best suited to circulating lubrication.

A broad division gives us two types: (1) gravity circulation and (2) pressure or force-feed circulation. The first is essentially an elevated reservoir, a sump or lower reservoir, a circulating pump, and necessary piping and fittings. The elevated reservoir, see Fig. 1, is above the highest bearing; oil flows by gravity to the bearings. From here it drains to the lower reservoir, frequently built integral with the machine base. The pump draws oil from the lower and delivers it to the upper reservoir. Oil pressure at the bearings depends, therefore, entirely on elevation of the upper reservoir. This pressure is seldom greater than 5 lb.

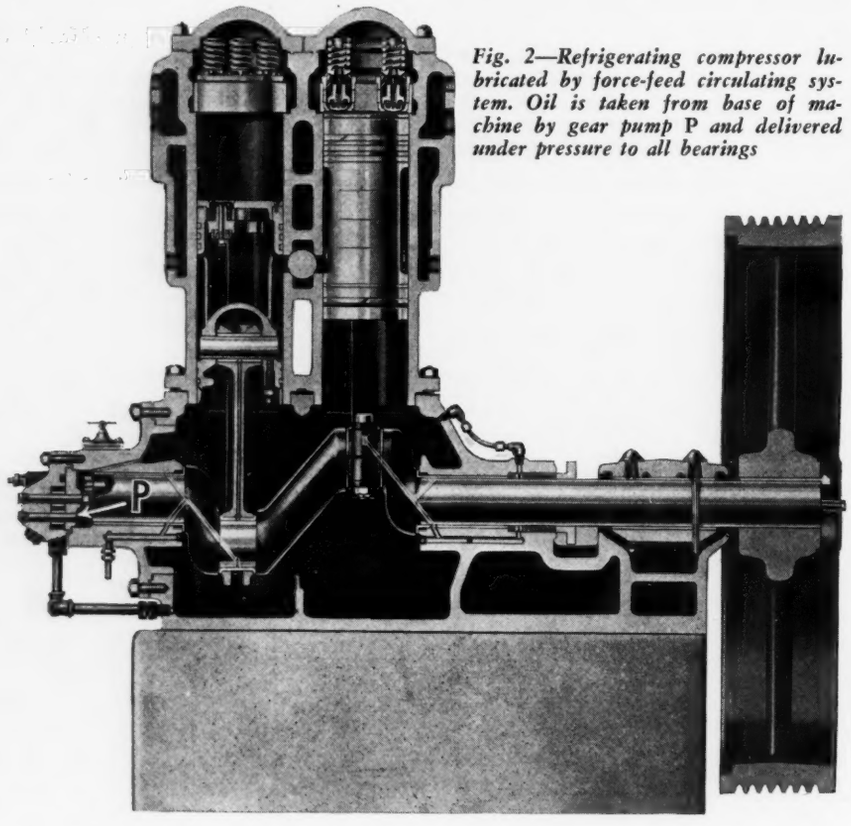


Fig. 2—Refrigerating compressor lubricated by force-feed circulating system. Oil is taken from base of machine by gear pump P *and delivered under pressure to all bearings*

Since oil pressure is usually low, it is good practice to provide strainers at easily accessible points in the supply lines for removal of foreign materials which might restrict and even stop oil flow. Supply lines should have sight-feeds so that rate of feed can be easily observed and properly regulated. While this system is suitable for steam engines, air compressors, and many other machines, it has been largely displaced by the force-feed system. The latter is more reliable and capable of supplying larger volumes of oil required for cooling modern high-speed machinery bearings.

A less costly arrangement of the gravity system is one in which the upper reservoir is omitted and the oil is pumped at low pressure directly to sight-feed cups over the bearings. This method does not provide a reserve supply of oil in emergency, such as pump failure. It is, therefore, less dependable than the more complete system.

A force-feed system delivers oil directly to each bearing under considerable pressure. Oil is drawn by the pump from a central reservoir below the lowest bearing and is pumped to each bearing, from where it drains by gravity back to the central reservoir. In such a system, oil pressure is controlled by (1) varying pump speed; (2) a pressure-relief valve; or (3) use of orifice sizes at the different bearings according to lubricating-oil requirements. The two latter are in more common use than

the former because the pump is usually driven at constant speed by the machine.

An application of the circulating system is indicated by Fig. 4, which shows it applied to a high-speed, large-horsepower, silent-chain drive. A constant spray of oil onto the chain provides a copious supply for both lubrication and cooling purposes. It also flushes the chain of dirt, grit, etc, which would cause excessive wear of the joints if not washed away.

Fig. 3 shows a small, vertical steam engine equipped with a complete circulating system for the external parts. This engine is completely enclosed and is oil-tight. An automatic water drain (not shown) removes any condensate that may accumulate in the oil.

Fig. 2 shows a vertical, duplex refrigerating compressor equipped with a force-feed circulating oiling system. Oil is delivered by the gear circulating pump *P* directly to the stuffing box, crankpin, wristpin, and two of the main bearings. The outboard main bearing has oil rings. Cylinder walls are lubricated with oil thrown from the crankpin and wristpin bearings. A filter is often put in the suction line of the pump in circulating systems of this type.

Perhaps the circulating oiling system has reached its highest perfection in its application to steam turbines, see Fig. 5 for a typical modern unit. Oil in this case is not only required to lubricate and cool the bearings, but also to act as the hydraulic medium operating the governor gear.

Oil is stored in a large tank and is water cooled in a separate cooler. From the storage tank, oil is normally taken by the main pump, forced through the cooler and then into a header from which a branch leads to each bearing. After passing through the bearings, oil flows by gravity in a return line to the storage tank. A strainer on the entrance to the tank catches any dirt that the oil may pick up while being circulated, or that may be in new oil being added.

Briefly summarized, advantages of the circulating system are:

1. Provides a copious supply of oil for both lubricating and cooling purposes.
2. Tends to flush bearings, gears, etc, of dirt and grit which may restrict oil flow and cause excessive wear.
3. Is positive, automatic, and the force-feed type is very reliable.
4. Oil consumption is minimized as oil is used over and over. If purifiers are installed, oil lasts virtually indefinitely in most cases.

Main disadvantage of the circulating system is its high initial cost.

Several centralized lubricating systems have been developed that deliver a measured quantity of oil to each bearing of a machine or a group of machines. These will be considered in a following article.

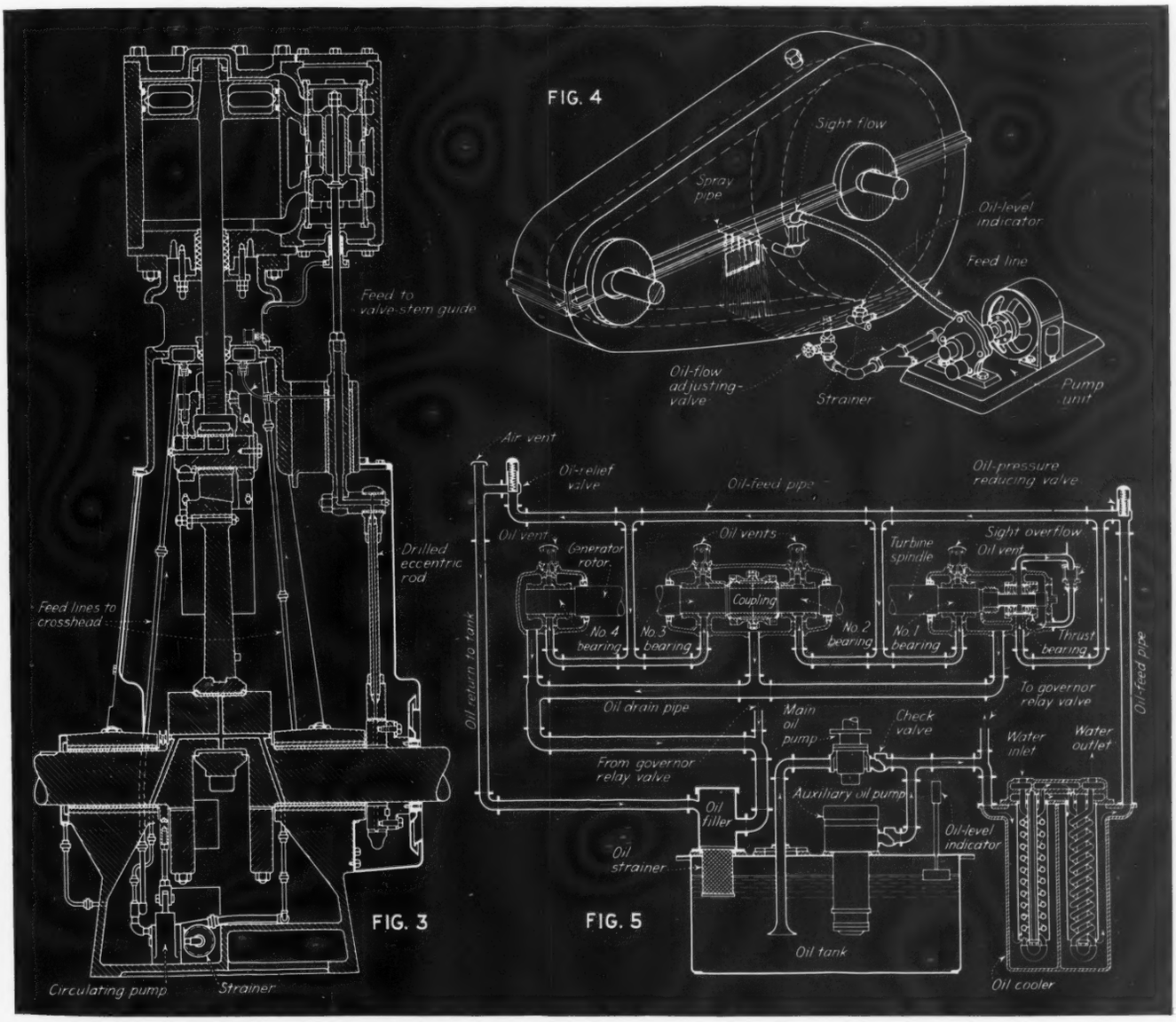


Fig. 3—Small vertical steam engine lubricated by force-feed system. Fig. 4—Silent-chain drive spray lubricated by circulating system. Fig. 5—Force-feed oiling system applied to a steam turbine

More Horsepower per Pound

Radical design innovations bring European steam prime movers close to diesel in economy and capacity per unit of weight—high pressures, temperatures and speeds do the trick

By MAX F A WULFINGHOFF

COMPARING diesel engines with steam-driven prime movers leads to the apparent conclusion that the diesel must show better economy and higher output per unit of weight because in the diesel, as in all internal-combustion engines, transformation of heat to power takes place in the cylinder, while steam prime movers require steam-producing equipment. Furthermore, oil engines would seem more suitable for small installations. However, European engineers have designed steam machinery which comes close to the diesel range of economy and capacity per unit weight.

Considering first the reciprocating engine, it should be remembered that mechanical efficiency of a well designed steam engine may be 10 to 15% higher than that of an oil engine, depending on the type. Raising initial pressure and temperature or using a suitable thermal hookup (reheating or regenerative cycles) boosts thermal efficiency of steam engines. Munzinger states (ZVDI 82, 1938, p 972) that by reheating twice, a fuel saving of 5% can be obtained with initial pressures of about 800 lb per sq in.

Reciprocating Engines

With reciprocating engines, steam temperature of 800 F is now considered generally practical; use of turbines permits going to about 950 F. In marine plants, pressures up to 700 lb are perfectly good practice, while 900-lb equipment has been tried in service.

European engineers consider that horizontal stationary-reciprocating units with multi-valve gear require too much floor space and run at too low speed for many applications. With outputs up to 900 hp and at initial steam pressures up to 250 lb, however, horizontal center-crank types with dust-proof enclosed crankcases and cross-head guide chambers lend themselves to forming a handy and compact arrangement mounted on top of a horizontal firetube boiler. This assembly, often encountered in European factories, requires a minimum of foundation work and is thus inexpensive to install. Elimination of external piping between boiler and engine further lowers cost and reduces thermal and frictional losses. This sort of unit often operates non-condensing for the sake of simplicity, and can be supplied with feedwater of less than average quality and almost any sort of fuel.

Modern lightweight reciprocating engines for high-pressure or back-pressure jobs are vertical enclosed, self-oiling, with speeds ranging from 500 to 1000 rpm. Short stroke, about equal to cylinder diameter, reduces thermal losses. Piston speeds between 900 and 2700 fpm are standard practice.

Fig. 1 shows an unusual arrangement (German Patent No. 537,773) of a unaflow duplex steam engine with piston valves. Exhaust slits in the cylinder eliminate unnecessary heat dissipation and thermal stress. Inlet ports are at cylinder ends; cylinders are arranged symmetrically to the block center line and cranks are offset at right angles. Short steam passages and more uniform temperature distribution in cylinder walls result.

A common eccentric, actuating two

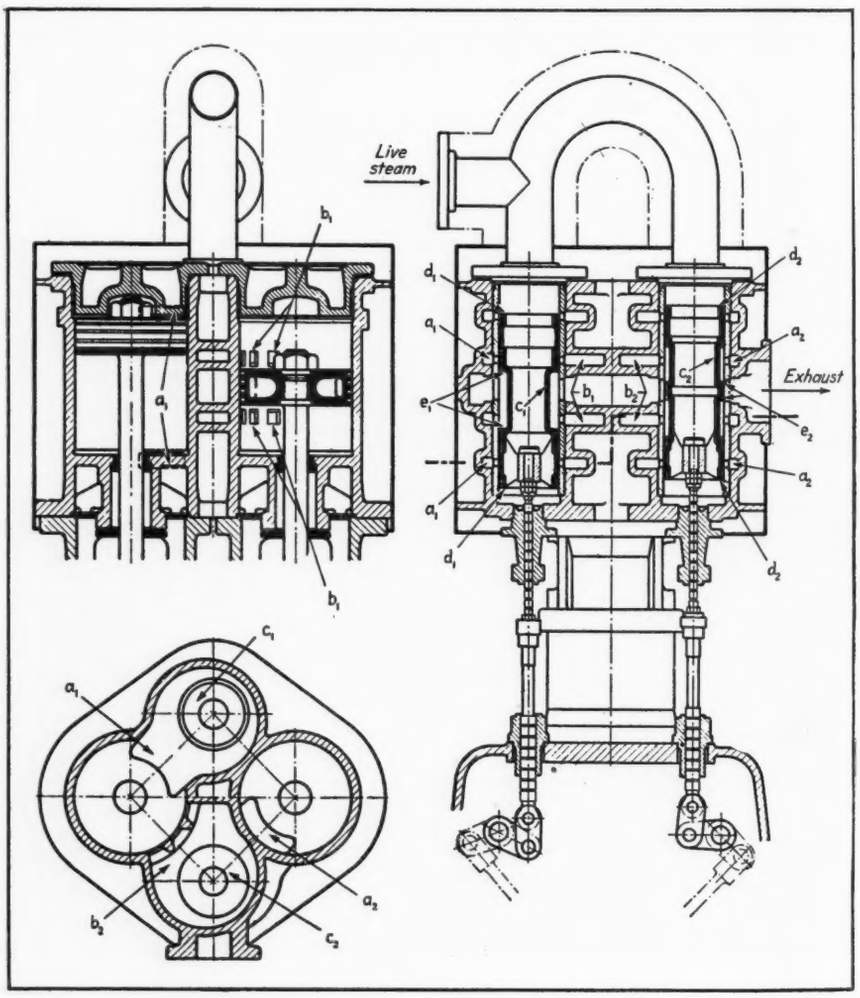


Fig. 1—Unaflow duplex steam engine with only one piston valve per cylinder

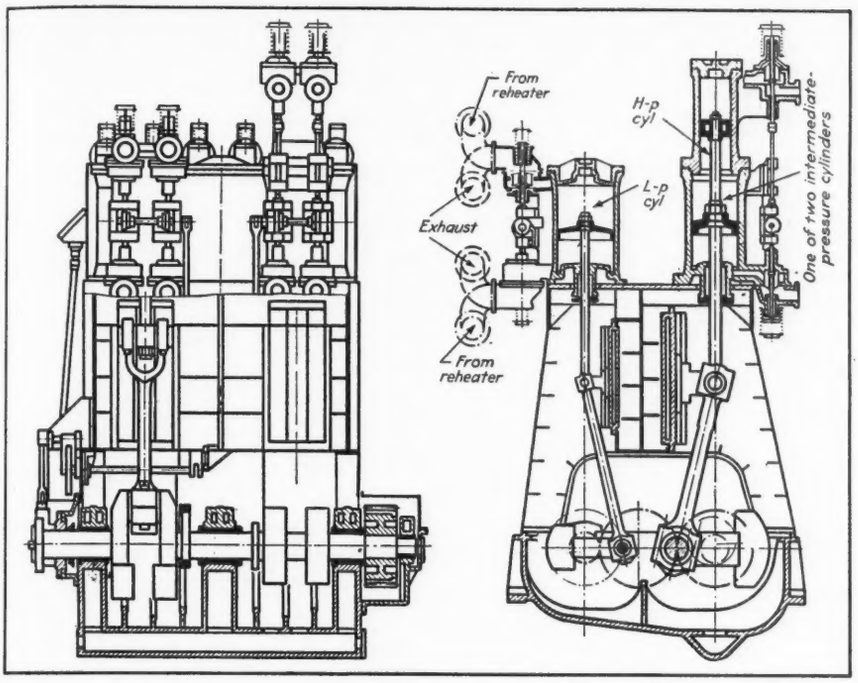


Fig. 2—Compound marine engine with two crankshafts

eccentric rods 90 deg apart, operates both valves. Edges d_1 and d_2 of pistons c_1 and c_2 control steam admission; as soon as these edges clear inlet ports a_1 and a_2, steam enters cylinders. Exhaust ports b_1 and b_2 are opened and closed by inner edges e_1 in case of valve c_1, and by edges e_2 of central shoulder in case of valve c_2. Slits first cleared by pistons connect with exhaust only after piston has also cleared second tier of slits and after exit of steam through this second row has begun. Release and compression are always constant.

With piston at end of stroke, liberal cross-section of both tiers of exhaust ports allows pressure equalization between cylinder and exhaust line; throttling losses are correspondingly low. By varying arrangement of exhaust slits and piston dimensions, compression may be adopted to suit any conditions of pressure, condensation, exhaust, or backpressure.

An engine of this type working between 220 lb, 610 F at throttle, and 3 lb backpressure, produced 250–350 hp at a speed of 500 rpm, on a steam consumption of about 15–16 lb per hphr.

Following a design by O Hartmann, marine compound engines have been built with two crankshafts running at different speeds. The higher rpm of the low-pressure parts permits reducing the size of the otherwise unduly large low-pressure cylinder. Fig. 2 shows an engine of this design supplied for an output of 275 hp. Trottle steam, at 825 lb and 820 F, goes through quadruple expansion and is reheated twice. Crankshaft speeds are 200 and 500 rpm. Steam consumption, including reheater, runs less than 6.4 lb per indicated hphr. This type is suitable where space is restricted, as additional gear set only takes a small fraction of the room saved by the unusual design.

In another double-reheating experimental reciprocating engine, taking steam at 785 lb and 1000 F, difficulties likely to be met with high-pressure, high-temperature stuffing boxes are avoided by providing single-acting high-pressure cylinders arranged in tandem (G Bauer, ZVDI 81, 1938, p 758). This 3-cylinder engine, combined with an exhaust turbine, operates at a heat rate of 7800 Btu per hphr, corresponding to a water rate of 5.3 lb per hphr. These results were obtained on a unit producing about 1000 hp at 133 rpm. The engine mechanical efficiency is close to 86%.

Use of high pressures and temperatures and concentration on reduction of weight both affect engine construction.

Thus, one reason for preference of vertical types lies in the fact that piston rods are not subject to gravity bending strains. At extremely high test speeds, fissures in piston rods and cross-heads caused by bending vibrational efforts had occasionally developed. Critical torsional vibrations had also been observed.

When cylinder blocks heat up non-uniformly, especially with extremely hot steam, deformation of cylinders and valve housings causes difficulties with pistons and valves. Machinery of this kind must also stand occasional rapid temperature changes. Thin walls, good diffusion of heat and use of materials with low heat-expansion coefficients now reduce stresses.

Designers of reciprocating engines seek for perfect static and dynamic balance, shunning avoidable mass influences such as excessive radial forces from the crankshaft. Internal balance is as important as avoiding resonance by providing sufficient rigidity and adequate insulation against transmission of vibrations.

In search of lightness, both ingenuity of construction and higher-grade materials are employed. Close investigation also permits distributing service stresses more evenly over affected parts. As any form of connection between machine parts, with possible exception of welding, means increased weight, designers gain much by clever combination of the smallest possible number of elements.

Refined methods of forging, casting, and welding, help in achieving low-weight elements without unnecessary accumulation of dead masses. Welding saves weight in foundations, gear housings and condenser shells. Steam-engine builders now take a leaf from the internal-combustion-engine book and provide high-grade surface finishes, lower specific bearing pressures, improved lubrication details, and allowance for deformation in service.

Other Refinements

Crosshead guides, for example, are now found above the frame proper, permitting better cooling and easier access to gudgeon pin. Unnecessary turns and bends in steam passages are carefully avoided. Modern European reciprocating engines have cold-drawn phosphor-bronze gudgeon-pin bearings, and graphite-bronze inserts are found in distribution gear and governor bearings. Crankshaft and main bearings are of lead bronze with white metal lining and most builders employ pearlitic cast iron for pistons, piston bushings and piston rings.

Behavior of oil is one of the factors limiting superheat temperature. Eventual possibility of doing away with internal lubrication in reciprocating engines appears the likely solution. Suggested methods include use of piston rings requiring no oiling (carbon or certain plastics) and total elimination of any contact between piston and cylinder wall, with closest possible

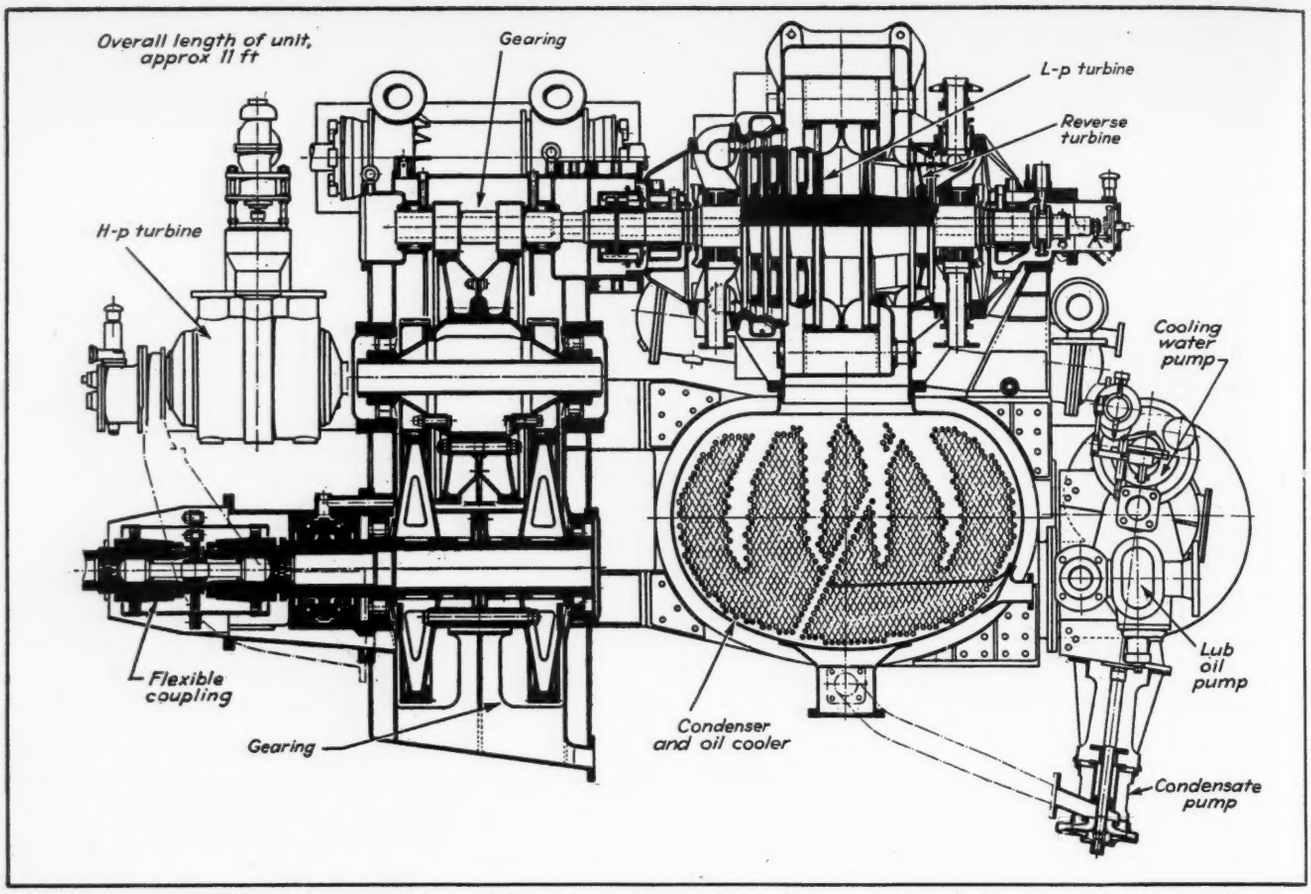


Fig. 3—Compact marine-turbine installation weighing about 5 lb per hp, including gearing, condenser, and auxiliary machinery

clearance. So far neither method has had sufficient trial.

K Trutnovsky finds (*Forsch Ing Wes*, 8, 1937, p 131) that with smooth cylindrical pistons the leakage increases with the third power of the running clearance width, where laminar flow prevails. Leakage increases with the 1.5 power of the clearance width in the turbulent range. In actual construction of steam engines, that is, with higher Reynolds numbers, better results may come from use of grooved pistons. Still, even in the latter case, maximum allowable clearances from standpoint of steam economy would be no more than 0.004 to 0.02 in., depending on engine size. As piston dimensions increase, useful surface goes up as the square of the diameter while length of clearance space only increases in linear proportion. This seems to indicate that the frictionless unlubricated piston will be realized first on larger engines. However, small cylinders are easier to machine.

Small turbines can also compete with internal-combustion engines in output per unit weight, largely because of constant driving torque. Such units running at high speeds hold down windage and clearance losses; as a general thing, high rotative speed means reduced over-all dimensions, lower thermal stresses and shorter time required for warming-up. Correct design combines easy supervision and a reasonable degree of reliability. Gearing is essential, but improved finish and good cooling have increased mechanical efficiency of single or double reduction gearing to a high point. It is also stated that small fast-running turbine rotors have better running balance than large slow-speed wheels.

5 Lb per Hp

As long ago as 1930, a European concern supplied turbines weighing about 5 lb per hp, including the condenser and auxiliary machinery. In the unit shown, Fig. 3, the high-pressure turbine produces 600 hp running at 21,000 rpm, with throttle steam at 570 lb and 700 F. Diagram shows relation of turbines, gearing, condenser, and auxiliaries for a compact marine installation. While unit weight of standard steam plant, including boilers, piping and all accessories, as well as water and oil, amounts today to 55–80 lb per hp, as low a figure as 25–40 lb per hp can be obtained for particular applications.

Turbine housings are usually split horizontally and suspended between bearings to obtain free expansion. Rotors have shrunk-and-keyed or solid disks, and most units are equipped with carbon glands. Provision of sufficient space between stuffing boxes and bearings avoids emulsifying of oil by steam. On stationary types, a hand-actuated speed-regulating device and a governor on a vertical shaft controlling a balanced double-seat valve are standard equipment. Lubrication equipment, mostly automatic, and often of the dual type, comprises an attached gear pump, oil reservoir with cooler and filter and a hand pump for starting.

As compared to rotors running above the critical speed range, sturdy shafts at safe speeds below the critical are preferred even in light-weight designs, as they offer less chance for vibration and wear of interstage seals. Designers reduce distance between bearings as much as possible and cut out all unnecessary material in moving parts. In making hollow shafts, cores provide samples for checking quality of steel. Special attention is given to the fact that forgings are seldom really homogeneous. Chances for non-homogeneity increase as forging size and percentage of alloy metals increase. In forging cast-steel blocks, strains expected in service have to be considered, as strength and ductility will vary according to degree of forging.

Modern European turbines often have molybdenum-steel casings, with chrome-alloy blades and nozzles. Nickel-chrome steel goes into gear pinions; in gear wheels, manganese-steel rims are frequently combined with hub and spider made of light-weight alloys.

Six Million Sq Ft to Heat

Supplying steam for process and heating to the world's largest group of loft buildings isn't an everyday power job, but Bush Terminal Buildings Co steam plant has features that can apply to anybody's modernization

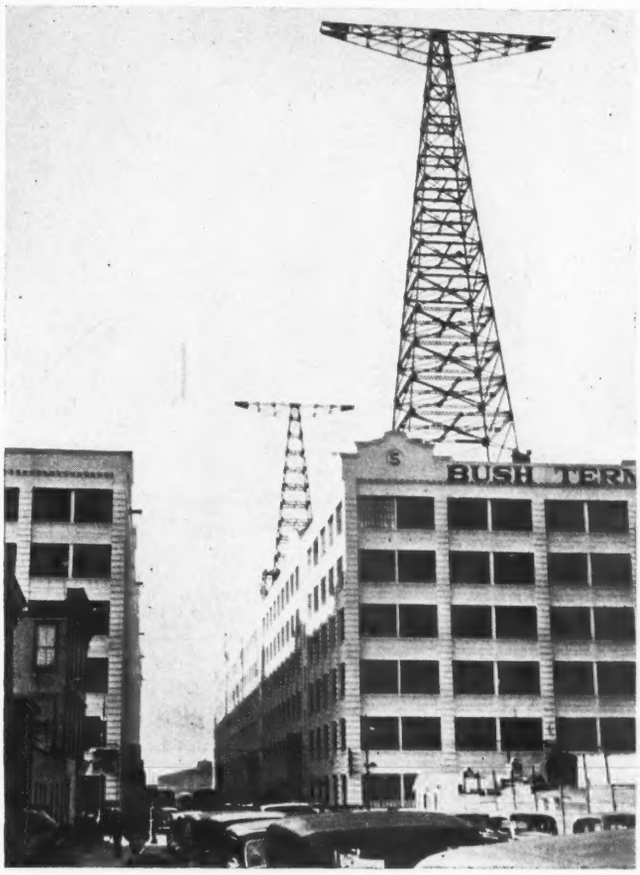


Fig. 1—Part of two reinforced-concrete loft buildings, of Company's total of sixteen. Total floor space, about 6,000,000 sq ft. Over 25,000 people work here

By WALTER W SLOCUM and PAUL R LUTZ
Day & Zimmerman, Inc, Philadelphia

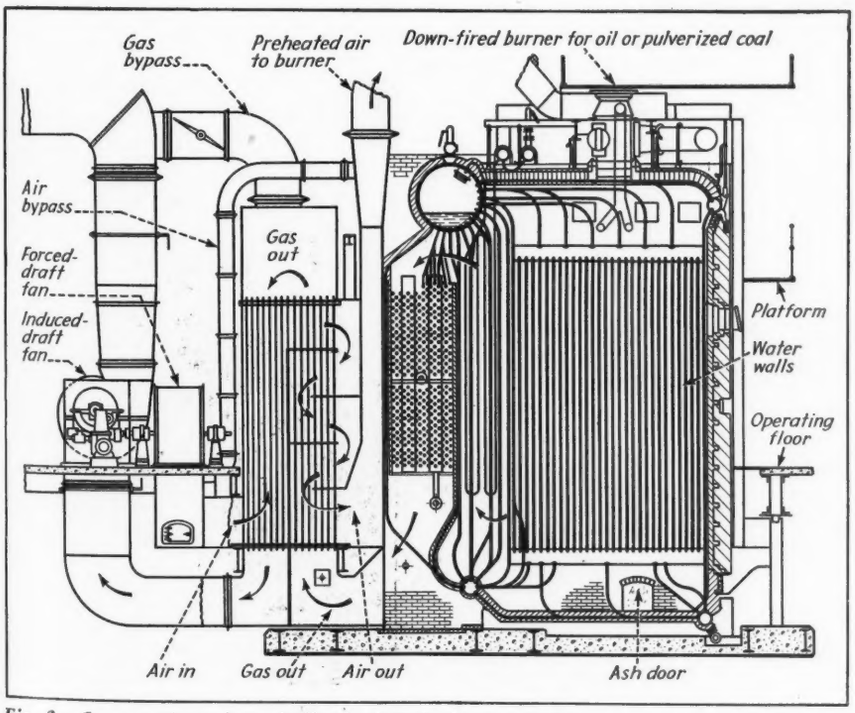


Fig. 2—Cross-section of vertically fired Badenhausen boiler unit supplying major part of 900 million lb per year steam load

ON THE WATERFRONT of New York Bay, Bush Terminal Buildings Co extends over ten full blocks housing an industrial city of 200 separate business operations and 25,000 employees. Sixteen concrete loft buildings have floor space of about 6,000,000 sq ft. Tenants include paper-box, candy, wine and precision-instrument manufacturing, communications, coffee and tea packing, and the world's largest dealer in olives. These operations require rail, steamship and trucking facilities and in addition a constant and reliable source of steam for industrial process and heating.

Prior to construction of the present plant addition this year, the company procured its steam from an adjacent steam plant. A company-owned standby plant supplemented such steam procurement during peak periods.

Improvement in efficiency, quality of steam service and benefits of ownership management have already become fact by the installation of a single modern steam generator designed to burn either

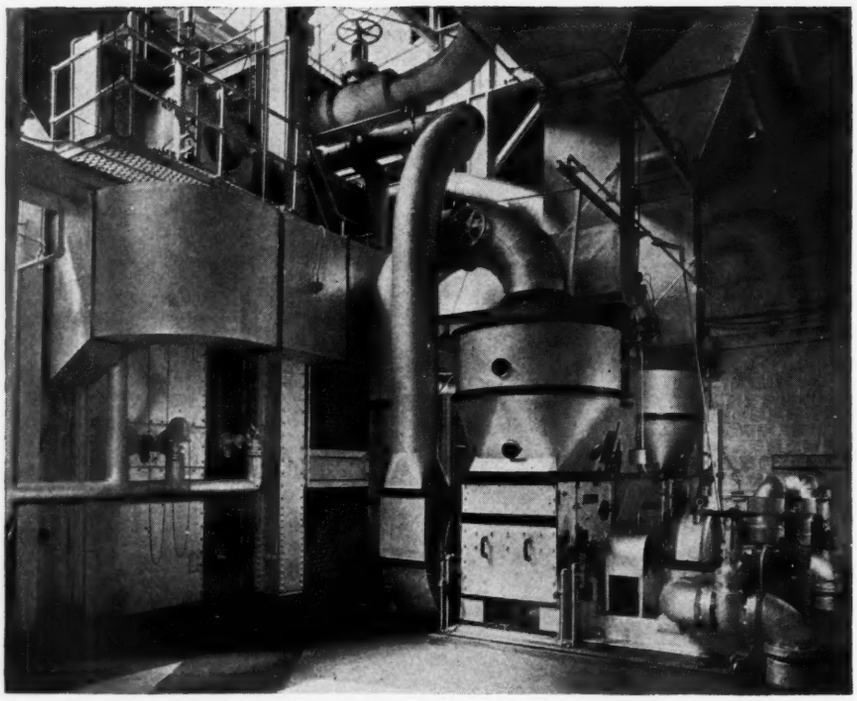


Fig. 3—Compact boiler and auxiliary arrangement suit existing building limitations

oil or pulverized coal. Load characteristics are such that the 120,000 lb per hour unit supplies over 85% of the 900 million lb of steam required per year, even though peak demand at present is about 240,000 lb per hour.

The new boiler and its auxiliaries occupy about half of a space 70x70 ft, 28 ft high, the other half being taken up at present by a storeroom and shop. This space was made available by removal of the stoker-fired units similar to the remaining eight 4400-sq-ft boilers now used for standby and peak-load.

The steam generator, designed by John Phillips Badenhausen for 120,000 lb per hr maximum continuous rating, has been operated for considerable periods at more than 130,000 per hour.

The furnace is completely cooled by bent water-wall tubes connected between round seamless-steel headers, hand holes of which are closed by metal-to-metal non-gasket type "Key" caps. Down-firing Peabody combination burners in the furnace roof inject fuel and air with great turbulence through the upper zone of hot furnace gas and bordering band of radiant refractory wall and roof. Gases leave the furnace at bottom and enter the lower end of the boiler tube bank, eliminating any bypassing at lower loads.

The furnace floor is water-cooled refractory for periodic dry ash removal by hand. The furnace walls absorb a large proportion of heat without danger of loss of ignition at lower loads.

The steam generator also is extremely compact so that 120,000 lb of steam at 650 lb, 650 F and 85% efficiency is produced in a unit only 20x35 ft, 35 ft high.

In order to effect such small over-all dimensions, the convection surface and water-preheating section are built behind the furnace. A relatively small amount of convection boiler heating surface is used, difference being made up by more effective heating surface in water preheater, or economizer.

The water preheating section is horizontal-tube counter-flow type; water flows upward, gas downward. All connections to the boiler drum are below water level to insure flooding at all times, offsetting water hammer or overheating conditions. The boiler circulation is positive and non-reversing. The down flow is through the rear tubes outside the water-preheating section where little heat is added, feeding the bottom boiler header. From this bottom point the circulation is upward, in two zones, vigorously in the waterwalls and less vigorously in the convection boiler surface. These circulations do not mix or intermingle again until introduced into the main drum. All active steaming tubes discharge above the drum water level and no turbulent action is produced by bubbling steam through the water in the drum. This arrangement insures against priming.

The superheater is of considerable interest as its coils are in the lanes of the convection boiler tube bank. In actual operation, the final superheated-steam temperature does not vary more than 10–15 F over wide load swings. This is unusual considering that no form of physical superheat control is used. As has been evident from the charts, the record of steam temperature is unusually uniform for loads from 65,000 to 130,000 lb per hr.

The air heater immediately back of the economizer includes two vertical tube banks, the first of which has tubes grouped and baffled to allow air entrance around the lower ends, preventing corrosion trouble at colder ends of tubes. The second air pass is baffled for cross flow. A bypass around half the air heater allows natural-draft operation at lower loads.

The primary features of the unit are simplicity and economy of construction at no sacrifice in quality. This is particularly evident in the single-drum design well suited for low-cost high-pressure units. It will be noted that all feeder and relief tube connections to the waterwalls are contained inside the furnace, giving a neat, clean-cut outside appearance.

The two coal pulverizers, because of unique underfeed, can handle wet coal and foreign material without trouble. Because renewal of cheap plate hammers is easy and quick, maintenance costs are low. A full-size classifier rejects and returns over-size particles to the grinding chamber.

All controls for the new boiler are confined to one operating floor, reducing personnel requirements to a minimum. An 8-point draft gage and complete set of steam and feedwater meters are grouped on a single panel with the combustion-control equipment. In addition to usual fuel and draft control, electrically actuated, a feature of the installation is an electric eye, Fig. 4,

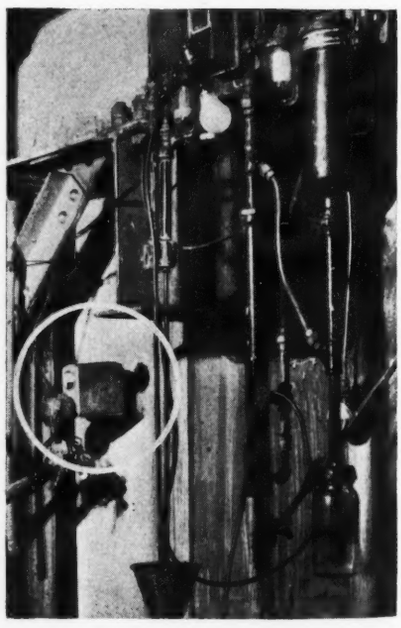


Fig. 4—Electric eye regulates combustion to the point of making a trace of smoke

Principal Equipment Bush Terminal Buildings Company

BROOKLYN, N. Y.

Steam Generator, including Boiler, Furnace, Economizer and Airheater:

Boiler and Water Walls.....Day & Zimmermann, Inc
One vertical-fired Badenhausen boiler; heating surface, boiler 3800 sq ft; water walls 2550 sq ft; water preheater section, 3600 sq ft; superheater 875 sq ft; airheater 16,500 sq ft; furnace volume 5300 sq ft; capacity 120,000 lb per hr maximum continuous, 650-lb working pressure, 695-lb design pressure, 650-F total steam temperature. Now operates at 150 lb, 450 F.

Auxiliary Equipment:

Coal pulverizers, 2-6500-lb-per-hr Strong Scott.....Mackenzie Engrg Co
Air swept Unipulvos, Swing-hammer, with classifier and integral fan
Drive turbine.....Moore Steam Turbine Co
2—direct-connected 60-hp, 1760-rpm, 150-lb throttle, 5-lb exhaust
Forced-draft fan.....Buffalo Forge Co
Double-inlet, 39,500-cfm at 10½ in. w.g.
Forced-draft-fan turbine drive.....Moore Steam Turbine Co
One 85-hp, 1760-rpm, 150-lb throttle, 5-lb exhaust
Induced-draft fan.....Buffalo Forge Co
Double-inlet, 72,000-cfm at 10 in. w.g., 400-F gas temperature
Induced-draft-fan turbine drive.....Moore Steam Turbine Co
One 178-hp, 1760-rpm, 150-lb throttle, 5-lb exhaust
Combination coal and oil burners.....Mackenzie Engineering Co
2 Type H-26 Peabody Toronto, 5900 lb per hr, mechanical oil-atomizing nozzle
Soot blowers.....Bayer Co
2 boiler, 2 water preheater
Automatic combustion control.....Brooke Engineering Co
Meters and instruments.....Brown Instrument Co
Mounted on Brooke control panel
Water columns and gage glasses.....Wright Austin Co

Feedwater System:

Deaerating heater.....Cochrane Corp
One direct-contact, tray-type, 8-ft dia, 250,000-lb-per hr flow, storage capacity 10,000 lb, 60% condensate, 40% cold makeup
Flash tank, 720-lb pressure.....Cochrane Corp
Boiler-feed pump.....Allis-Chalmers Mfg Co
130,000 lb per hr, 245-lb pressure, 265-gpm, centrifugal 3 in. x 2 in.
Boiler-feed-pump turbine, 65 hp, 3600 rpm...Moore Steam Turbine Co
150-lb throttle, 5-lb exhaust
Feedwater regulator, 3 in. Copes, "Flowmatic". Northern Equipment Co
Actuated by steam flow as well as water level

Piping System:

Piping Contractor.....Rowland Tompkins & Sons

which makes minor variations in the fuel-air ratio when oil is being fired, to keep combuston just below the smoking point, ideal for oil burning. The eye inspects the stack gas at the boiler exit and corrects the induced-draft regulator to control both variable speed on the turbine drive and auxiliary damper, until a trace of smoke interferes with the passage of the light beam across the flue. Automatic shutdown of fuel supply occurs on excess furnace pressure. Steam pressure is used to control fuel input by means of one regulator. Furnace draft is maintained substantially constant by a second regulator. Air input is controlled by a third regulator actuated from the electric eye located just ahead of the induced-draft fan. The theory of the control is that the most efficient point of combustion is with just a slight amount of smoke leaving the boiler.

The electric eye can be made extremely accurate under these conditions and it is claimed that CO_2 will be maintained with ½% of the best test conditions at all times regardless of load swings, and throughout a load range as great as 7 to 1.

The boiler is designed for 650-lb, 650-F steam conditions to provide for possible future power generation. All new main-steam piping is 900-lb flanged Van Stone up to the point where connection is made to the existing steam header. Feedwater piping is likewise designed for high-pressure operation, although present steam conditions are 150 lb, 450 F.

Turbine drives for auxiliaries are designed to operate at 150 lb and supply enough 5-lb exhaust to preheat feedwater to 220 F and Bunker C oil to 210 F.

A differential valve in the supply line to the oil burners maintains a constant difference in pressure at all loads. This valve reduces the amount of return oil at partial load.

An auxiliary water column is provided on the far end of the drum as a safety feature. Both water columns, safety valves and other auxiliary boiler equipment are good for 700 lb, 650 F. Additional low-pressure safety valves protect the low-pressure boilers and piping at the point of connection to the main steam header of the older plant.

Efficiency on official test during an eight-hour run averaged 88.7% at 97,000 lb per hr output when burning 18,100-Btu Bunker C oil. Operation to date has been satisfactory and the expected improvement in over-all economy has been obtained. The savings are reported as amply justifying cost of the new installation.

Design and construction has been carried out by John Phillips Badenhausen and staff of Day & Zimmerman, Inc.

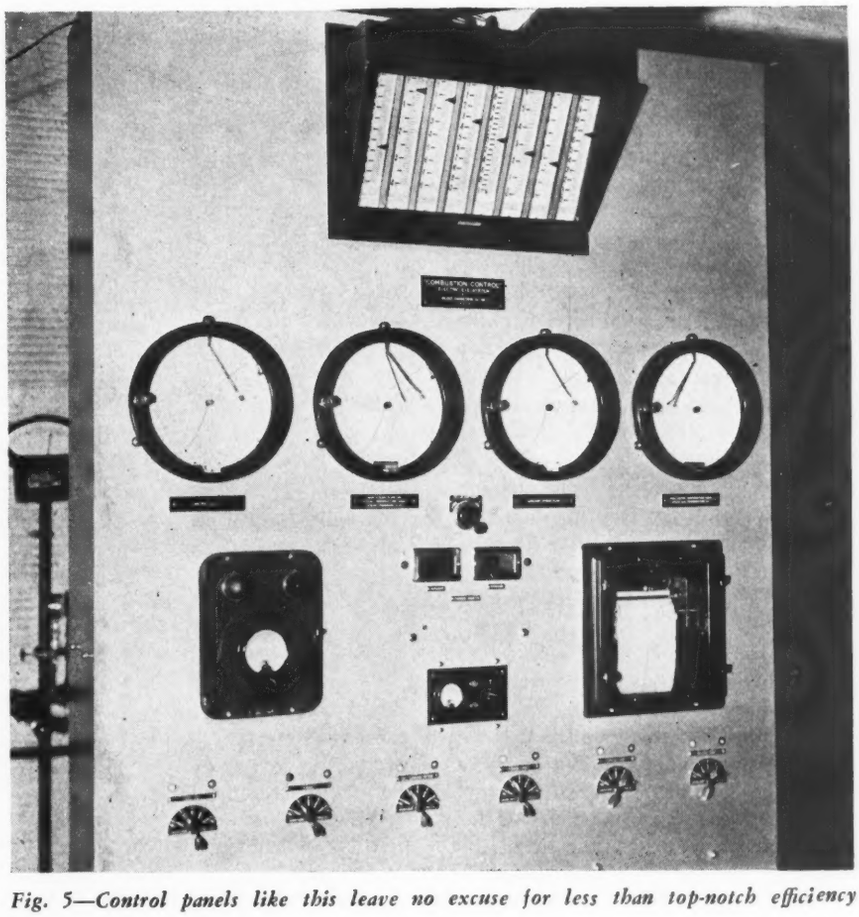
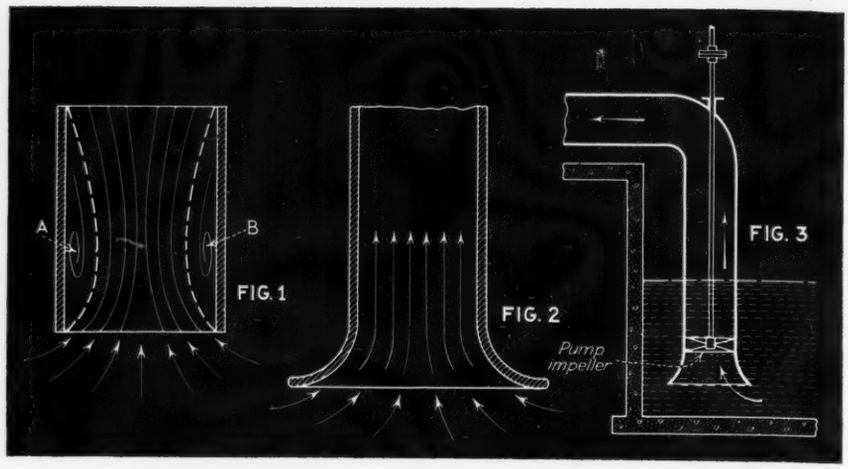


Fig. 5—Control panels like this leave no excuse for less than top-notch efficiency

Fig. 1—Plain pipe entrance increases pump suction lift. Fig. 2—Bell-shaped entrance guides water into suction pipe with practically no head increase. Fig. 3—Vertical installation where suction lift of pump is zero



How to Figure Suction Lift

A sequel to "Good Suction Means Fewer Troubles" in the May issue, discusses the elements that make up total suction lift on centrifugal pumps and shows how they effect operation

By RUSSELL K ANNIS
Consulting Pump Engineer, Ashville, N. C.

EVERY ENGINEER who selects and installs centrifugal pumps knows that most troubles start in the suction pipe. If this part of the installation is favorable to the pump, operation is likely to be satisfactory. If conditions are bad in the suction line, most anything can happen.

A mercury column, connected into the suction-pipe side wall close to the suction flange, gives a total-suction-lift reading, which is then converted from inches of mercury to feet of water. To this add the vertical distance in feet from the point where the gage is connected, to centerline of the pump shaft. Such a reading is not necessarily maximum pump suction lift, but the suction under test conditions. The gage reading, if connected into the side wall, will automatically include velocity head, as specified by the pump manufacturer, without further correction.

The mercury-gage reading can be obtained only when the suction pipe is already in place. Where plans are drawn in advance of installation, total suction lift can be only calculated.

Entrance Losses

Vertical lift to the floor line, plus friction of pipe and fittings, is often taken as total suction lift. This is a mistake. Vertical distance from floor line to the pump-shaft centerline, entrance loss, and velocity head must be added. The latter two are *not* the same. Where an entrance bell or a generously proportioned foot valve is used, entrance loss can be considered as practically zero.

Fig. 1 shows why a plain piece of pipe without a suction bell causes a suction loss. Water entering the pipe opening flows from all directions as shown by the arrows, causing eddy currents as at *A* and *B*. These currents, in effect, partially close the pipe opening so that flow is restricted within certain limits, indicated approximately by the dotted lines. There are many suction pipes like this, even though the practice is wrong. Head increase in a plain pipe end may be taken as equal to 85% of the velocity head. Of far more importance than the head increase in the end of a plain pipe are the eddy currents. These may be carried into the pump and cause cavitation and other troubles.

Where an entrance bell is used, flow is uniform with no eddy currents, see Fig. 2. Tests show that head increase under these conditions is seldom greater than 5% of the velocity head, provided bell-mouth diameter is equal to or greater than twice the pipe diameter. Head increase in elbows and valves may be obtained from tables published in hydraulic handbooks.

Head increase due to a foot valve varies over a wide range; it pays to use a large-size one and to be sure it does not seriously restrict flow at the suction entrance. The foot-valve strainer will clog quickly or slowly depending on amount of trash in the water, and total suction lift at the pump will consequently increase. Make the foot valve accessible for inspection and cleaning. Wherever this is impossible, omit the valve and use an ejector or other source of vacuum for priming. As an alternative, mechanically operated strainers are on the market, which do not require frequent attention. These are handy in sewage pumping.

Avoid abrupt changes in pipe diameter. By using tapered reducers, effect of changing from one diameter to another is negligible. However, length of the taper should be added to the smaller-size pipe length when computing pipe friction.

In addition to friction and entrance losses in the suction pipe, velocity head of the water at pump suction must be considered. This is computed from the formula $Velocity\ Head = V^2 \div 2g$, where V is the velocity of the water in the pipe in feet per second and g the gravitational unit 32.3.

When a centrifugal pump is tested at the factory to measure maximum suction lift, it is first operated at low suction lifts to establish its normal capacity, head, and efficiency. The test is then repeated at a slightly higher

suction lift. If performance is not affected by this change in lift, suction is increased in gradual steps, until a change in performance occurs. From this point on, performance gets worse and worse, as suction lift is further increased. The point where pump performance starts to slip off is known as maximum suction lift.

Most pump manufacturers have complete data on maximum suction lift for their standard pumps, under all combinations of speeds, heads, and capacities, so it isn't much trouble to obtain this information before installing a pump.

One of the old rules for pumps now obsolete but still used occasionally, states that maximum suction lift should not be over half the total head. This rule is certainly not of any great importance, as there are pumps with suction lifts far above this limit that give very satisfactory service. Under certain conditions, the entire head can be suction lift. For example, Fig. 4 shows a Wood screw pump, as installed in the average drainage or irrigation pumping station. Here the suction lift, as shown by *S*, is greater than the total static head *H*. When the pump is installed in this manner, discharge head is always negative. Many of these pumping stations are working successfully in the United States, practically all being similar to Fig. 4.

Ability to draw water by suction to a height greater than total static head on the pump is not confined to screw pumps. Fig. 5 shows how an ordinary centrifugal pump, either single or double suction, can be installed. Many such pumps are used along river banks, for drainage and irrigation. The pump, installed on top of the levee with its suction pipe submerged into the drainage ditch, discharges into the river on the other side. Always submerge the discharge pipe, where possible, to take advantage of syphoning effect.

In this type of installation, the entire pumping system is under a partial vacuum and air leaks must be carefully guarded against. Even the casing discharge passages and discharge pipe are under a pressure less than atmospheric. Therefore, stuffing-box sealing water cannot be obtained from the pump itself and it is necessary either to keep the packing glands tight, or obtain sealing water from an outside source. If packing is tight enough to prevent air leakage, it usually causes rapid wear, and requires oil or grease lubrication. Separate sealing water is preferable if available.

Screw and propeller pumps are essentially low-head units, and they usually can operate with fairly high suction lifts. Increasing the speed of these pumps will produce higher heads, but, as speed of any pump is increased, suction lift is reduced. For extremely high heads, it sometimes happens that no suction lift can be allowed. In such cases, set centerline of pump below suction-well level. As a general rule, this is most easily done with a vertical pump so placed that its impeller is always submerged.

Ordinary centrifugal pumps operated at extremely high heads have the same suction-lift limitations as propeller pumps, especially in large sizes. No simple rule can be given for suction lift, because of the rather complicated relation between total head, capacity, speed, and suction lift.

Pump Performance

Manufacturer's guarantee of pump performance is usually based on a suction lift for clear cold water, at 60 to 80 F, and at sea level. When handling liquids other than water, a correction must be made for specific gravity. Reduce suction lift in direct proportion to specific gravity of the liquid.

If the temperature is over 80 F, or at any temperature for extremely volatile liquids, make a correction for the vapor pressure. This is the reason, as is commonly known, that boiler-feed pumps handling hot water, must have a positive suction head.

Altitude affects suction lift to the extent of approximately 1 ft of lift for every 1000 ft of altitude above sea level.

A common mistake in estimating total suction lift is to base velocity head at the suction flange on an assumed diameter, then to purchase a pump with a suction flange smaller than the diameter assumed in the estimate. This will cause the total dynamic suction lift to be higher than estimated. Often, the difference is enough to mean the margin between successful and unsuccessful operation. You can avoid this trouble either by finding out exact diameter of the pump suction in advance, or by telling the pump manufacturer the estimated diameter and requesting him to be responsible for any deviation in performance due to a difference in suction diameter from that assumed.

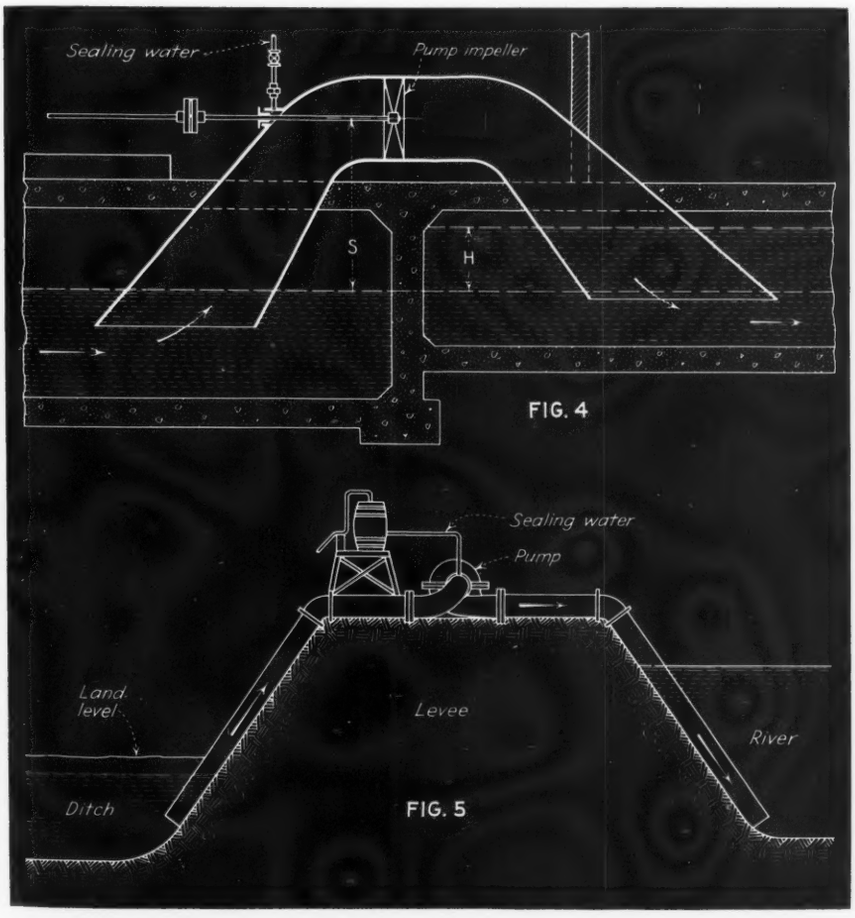


Fig. 4—Wood screw pump operates at high efficiency with suction lift greater than total head on pump. Fig. 5—Centrifugal pump on top of levee has high suction lift

Three Steps to Better Diesel

Indicators fitted to diesel work, improved valves and drum drives, and clear understanding of diagram meaning and limitations will make indication as useful and practical for diesel as steam plants. Here's a sum-up of five year's research leading to a new indicator design.

By K J DEJUHASZ

Associate Professor of Engineering Research, The Pennsylvania State College

SINCE JAMES WATT got the idea, indicators have told engineers what goes on inside cylinders of reciprocating engines. No one today seriously disputes the usefulness of indicator diagrams for diagnosing engine condition, but where steam-engine operators indicate often and confidently, diesel operators do so rarely and with misgivings. Substitutes—measuring exhaust temperature, listening to explosions from an opened cock, measuring mean pressure on the time basis—usually take the place of the indicator. Why?

Obviously, indicating a diesel is a different story from casually taking cards on a steam engine; diesel indicating puts greater strain on both instrument and operator. Diesel pressures and temperatures are higher; pressure rise is more rapid. Gas lacks lubricating properties of steam carrying cylinder-oil vapor; operator *must* keep indicator lubricated. Indicating a diesel leaves no room for mistakes. Accidentally leave a cylinder cock open when working with steam and no real harm is done; do it with a diesel and you have a red-hot valve and indicator, both probably seriously damaged.

Still, if diesel faults showed as plainly on cards as do steam-engine troubles, and if indicator errors could be easily spotted and eliminated, operators might go to the extra trouble and indicate their diesels regularly. Unfortunately, this isn't the case. Diesel diagrams tell their story only to experts. Even assuming that errors due to friction, displacement of drum drive or cord stretch, are eliminated and the diagram gives a true picture of the engine cycle, the operator still finds it hard to diagnose engine condition. Diagram irregularities may come from different engine troubles and usually the operator must start with cards taken when the engine ran perfectly; these are "good" cards for his particular engine and may be used for comparison.

In the face of these difficulties, many operators question the usefulness of the diesel indicator. However, in spite of everything, only the indicator can tell what goes on inside the cylinder. The answer, then, lies in getting rid of the difficulties. There are three necessary steps toward this goal: (1) fitting the indicator for diesel conditions, (2) improving accessories such as valve and drum drive, and (3) learning more about indicator limitations and about reading diagrams.

The Pencil Indicator

First, let's look at the indicator itself. Taking the average operator's standby, the pencil indicator of normal size, and leaving out of consideration high-speed indicators yielding small diagrams by optical or electrical methods, it can be seen that inventors bent on improving the indicator thought in terms of the steam engine. Internal-combustion engines brought some changes (provision of smaller indicating pistons to cope with higher pressures, and makeshift lubrication), but thorough re-design was needed to make the indicator do a decent job with diesel engines.

What are the requirements of a diesel indicator? The author thinks they are: (1) low inertia of pressure-measuring and drum parts to enable use at moderately high speeds, (2) ability to stand high temperature and corrosive effects of combustion products, and (3) conveniently large diagram size. Above all, a diesel indicator must be rugged, foolproof and convenient to use. These requirements point to a general arrangement and method of operation similar to the normal pencil-type, external-helical-spring indicator, and to a design featuring improvements in arrangement, materials, and construction, rather than radical changes.

Photograph and drawing show an indicator (U.S. Pat. No. 2,040,082), designed to meet these requirements. It comprises 5 sub-assemblies: (1) body, (2) pressure-measuring and recording elements, (3) piston lubricator, (4) card drum, and (5) cord-pulley assembly. Principal dimensions and data are summarized below the picture.

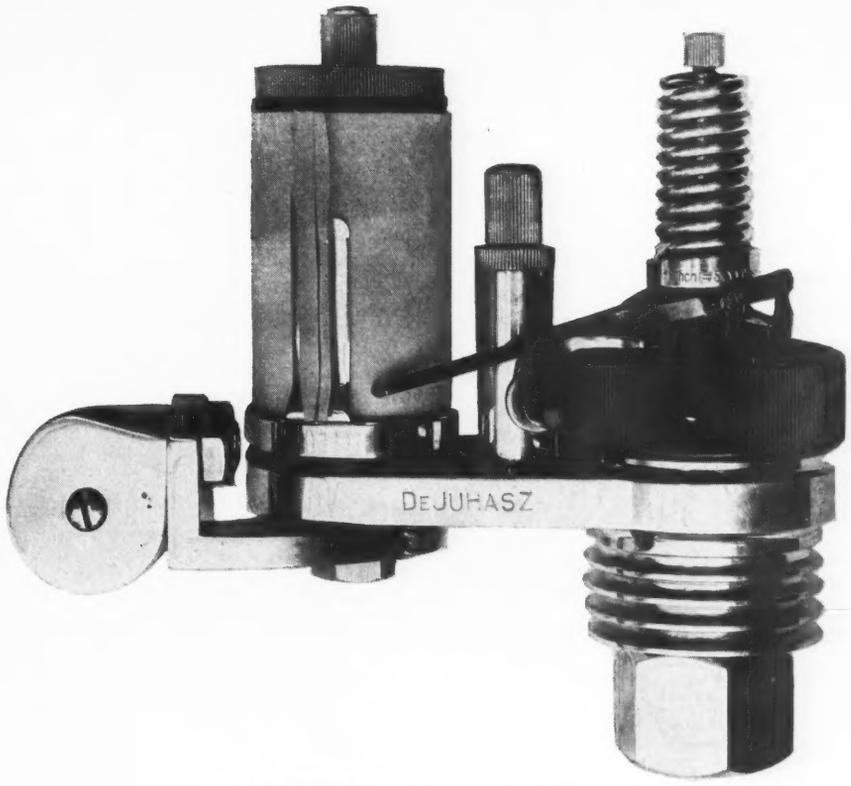
Indicator Details

Cooling fins on the body, a rugged bronze casting, dissipate heat and make handling easier. Indicator joins valve by a 1-1/16-in. x 10-thread-per-inch Whitworth union nut, which is accepted standard for most indicators. Substituting a regular hexagonal nut for the usual wing nut reduces danger of burned fingers.

Cylinder head, piston rod, piston, cylinder, spring, and pencil movement are mounted on the turntable; the whole group fastens to the body with a sturdy lockring having a wide Bakelite grip for better heat insulation and for protection of unavoidably delicate pencil-movement parts. Accurate centering of piston in cylinder, resulting from centering both piston rod and cylinder on cylinder head, reduces friction, binding, and leakage.

The short hollow piston rod cuts inertia errors and a long guide in the cylinder head prevents buckling. The double-wound helical spring fastens, at its lower end, to the cylinder-head upper extension, and, at the upper end, to the top of the piston rod by a swivel joint). The spring works in tension; this arrangement and the long piston-rod guide in the cylinder head eliminates buckling tendencies and all side forces in both piston rod and spring, insuring accurate concentricity of axial forces.

Indication



INDICATOR DIMENSIONS

Over-all Dimensions: 5½x5¾x2⅜ in. (140x146x60 mm)

Drum Diameter: 1 9/16 in. (40 mm)

Card Size: 2½ in. high by 5½ in. long (63x140 mm)

Maximum Diagram: 2 in. high by 3½ in. long (50x90 mm)

Magnification Ratio of Pencil Movement: 7:1

Magnification ratio of the recording mechanism (of the widely-used Crosby type with forked recording lever) is 7:1, which compares with 6:1 for indicators in about the same size range. The short, light, recording lever reduces inertia forces. The turntable itself, and the pencil motion mounted on it, can be oscillated for about 40 deg about the upper extension of the cylinder head as an axle. A tapered crosspin joins pencil movement and piston rod, a well-tried and satisfactory method. Special efforts to reduce mass at end of recording lever resulted in use of a small piece of pure silver wire as a stylus, fastened to the lever by a chuck with springy jaws. A stop collar on the piston rod limits motion and thus avoids excessive strain on the spring.

Position of lubricator between indicator cylinder and drum post avoids interference with mounting and operation of instrument and allows its use as a stop for the adjusting screw regulating stylus pressure. A regular grease-nipple fitting permits easy filling with lubricant; spring-loaded piston feeds lubricant at steady pressure to working surfaces of cylinder and piston. Position of upper knob acts as tell-tale, showing when lubricator needs filling.

Advantages of Drum

Drum post, drum, spring and drum head can be removed from the indicator body as a unit. Bakelite drum, molded in one piece, has these advantages: (1) a mass about 30% of that for a metal drum of the same size reduces cord forces and errors due to cord stretch and drum inertia, (2) thick rigid walls of Bakelite resist injury better than usual thin-gage metal walls, (3) ball bearings reduce friction and backlash due to wear, (4) paper clips are integral with the cord collar which encircles, by press fit, the lower part of the drum and produces a strong, light construction resisting centrifugal forces occurring at high speeds, and (5) one end of the drum spring is anchored in the drum head which engages, like a socket wrench, with the hexagonal upper end of the drum post fixed rigidly in the body arm. This permits easy adjustment of drum-return-spring tension. A knurled-head screw, serving also as a lubricator nipple, holds the drumhead in position. Two keyways in the lower end of the drum post and a single locating pin in the body permit use as a right-hand or left-hand instrument.

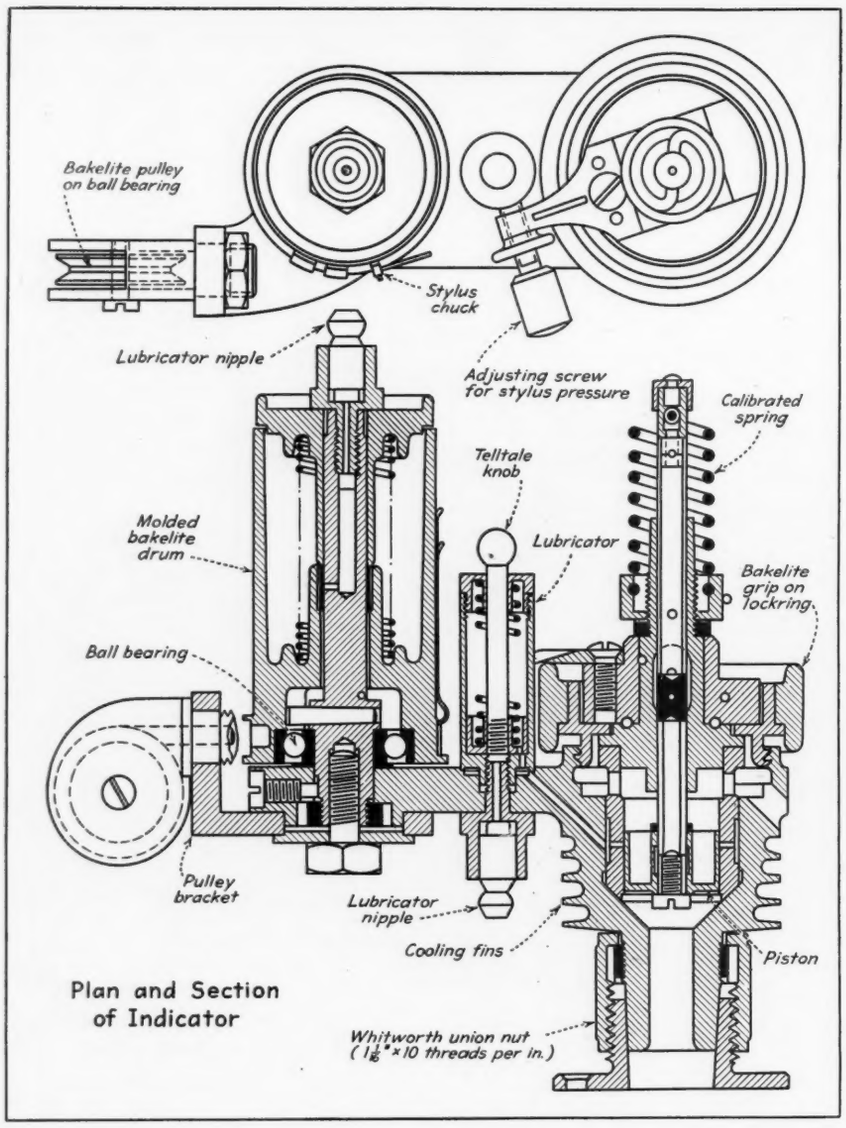
The pulley bracket centers in the body, fastened with bolt entering the lower end of the drum post, and is on a swivel. The Bakelite pulley runs on a ball bearing.

So much for the indicator itself. How about its mounting—the indicator valve and drum drive? Belonging partly to engine and partly to indicator, the valve is an orphan, getting full attention from neither engine builder nor indicator designer. In the author's opinion, it belongs to the engine and its design should be the concern of the engine builder. Engineering the valve as part of the engine would make possible water cooling of valve parts to improve reliability of operation. In most cases the connecting passage could be made shorter and straighter, eliminating errors caused by addition of a long tortuous passage to the combustion space, by wire-drawing, and by inertia of the gas column.

Slenderness of the diesel diagram means large percentage errors result from small inaccuracies in recorded area. Faulty connection to the engine shaft, cord stretch, backlash somewhere in the drive, or yielding in some part of the mounting commonly cause inaccuracy in recording. Only careful design of the drum drive will eliminate them. Thus, a long indicator cord adds to drum mass and throws an extra load on the drum-return spring. Bring the drum drive as close as possible to the indicator, using rigid, positively driven elements, and keep length of cord, or better, wire, short.

Design Drive with Engine

Best time to design a fully satisfactory drum drive is before the engine is built, and the author believes the drum drive should be incorporated in the engine design as a permanent accessory, like the lubricating pump or the governor. Engine manufacturers may well raise the objection that cost would be prohibitive, but the fact re-



Plan and Section of Indicator

mains that the drum drive should be built well or not at all.

However, it is only when mean indicated pressure is to be determined that a drum drive is necessary. The operator who wants only to judge combustion conditions will find time cards or pull cards sufficient. Thus, it appears to me that a time drum, which would not be heavy or cumbersome, would fill a definite need in this field. The operator is better off with less data, reliably obtained, than if he places unwarranted confidence in a full card obtained by an unreliable makeshift drum drive.

But improving the indicator and its accessories is only part of the story. Getting a useful diagnosis of engine conditions from diagrams rests on knowing the limitations and errors of indication. It is impossible to cover this ground here. Osborne Reynolds treated this subject in full detail for the steam-engine field, but we need a new survey of the situation, in view of indicator improvements, conditions in diesel engines, and the more varied uses to which indicators are put. The Engineering Experiment Station of Pennsylvania State College plans an investigation to answer questions such as: "What indicator and spring-piston combination fits a given engine and its running conditions?" "How accurate is recorded maximum pressure and indicated mean pressure?" "How dependable are compression and expansion lines for judging progress of combustion and leakage?" "How can we increase accuracy?" Results of this study will benefit makers and users of indicators alike, by clarifying abilities and limitations of different types used under various operating conditions.

Finally, what of future trends and possibilities in diesel indication? The improved indicator described here suits moderately high-speed engines of fairly large output, but it cannot claim suitability for high-speed engines approaching the automotive type. In this respect, number of indicator vibrations during an engine revolution constitutes a well-known criterion of suitability of indicator to engine. Allowable number depends on the purpose of the test, but it can be taken as 15 or 20. This means, even at 1000 rpm, a natural frequency of 250 cycles per second.

Can't Have Everything

Wishful indicator users sometimes say "give us a pencil-recording indicator easy to mount and operate that will work on high-speed engines and supply a large diagram". Unfortunately, if any two of these wishes are met, the third is automatically ruled out. If the operator will scale down demands on indicator size, considering a diagram about 1-in. high as sufficient, then the pencil-recording feature can be retained up to fairly high speeds, say about 1500 rpm. General acceptance and use of the Maihak cantilever indicator, the Lehmann-Michels, Rosenkrantz, and other special indicators testifies to this.

Beyond the range of these instruments lies the field of optical and micro indicators, whose use brings the unwelcome complications of microscopic and photographic recording. In the opinion of the author, development of an indicator for routine tests on high-speed engines will come from these two directions, with stroboscopic and electrical indicators restricted to use in laboratory research and development.

Power North of the Arctic Circle

The Royal Board of Water Falls, Stockholm, Sweden, recently ordered a 35,000-hp, 180-ft-head, 214-rpm Francis turbine from Nydquist & Holm, Trollhattan, for the Porjus plant. This plant, on the Lule River, is 46 miles north of the Arctic Circle, and has a present capacity of 100,900 hp (see POWER, June 23, 1931).

The new unit is a double-runner, horizontal-shaft turbine and will have a spherical casing instead of the usual cylinder type. Temperatures at the plant frequently drop to —50 F and severe winters extend from August to June. Generated at three different frequencies, 15, 25 and 50 cycles, power from this plant serves electric railways, mines and industries over a wide area in Lapland and northern Sweden.

2000-Lb Pressure for Brimsdown

BRIMSDOWN A, old station of England's North Metropolitan Electric Power Supply Co, Ltd, dates back to 150-lb pressure and vertical Curtis turbines. Today, this new section, towering above the shell of old Brimsdown A, houses two Loeffler boilers, each generating 210,000 lb of steam per hr (max. continuous) at 2000-lb pressure and 940 F.

After expansion to 195-lb pressure in a 20,000-kw turbine, steam is reheated (by high-pressure steam and flue gas) for final use in a 30,000-kw condensing machine. Over-all station efficiency, not yet officially announced, is said to be remarkably high.

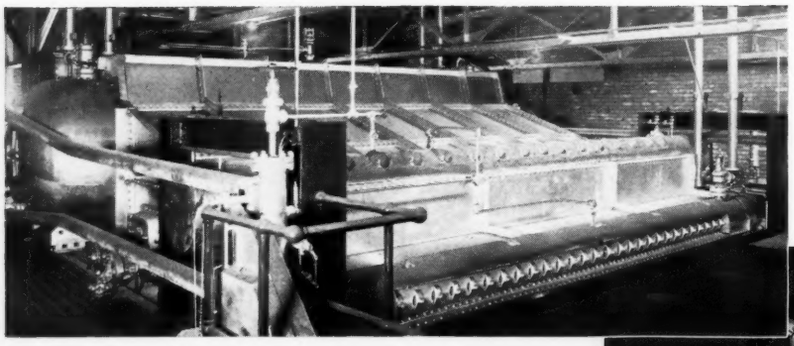
Two more 250,000-lb-per-hr units, same steam conditions, have been ordered for the newer Brimsdown B (right background). All four boilers are supplied by Mitchell Engineering Co, Ltd, of London, who hold the British rights on Loeffler boilers.

The Loeffler boiler, in use for some years on the European continent, generates no steam whatever in tubes exposed to furnace or gas heat. Aside from the economizer, the entire system for absorbing furnace-generated heat consists of huge radiant and convection superheaters, through which high-pressure steam is pumped at high velocity. An auxiliary boiler is used to get up pressure.

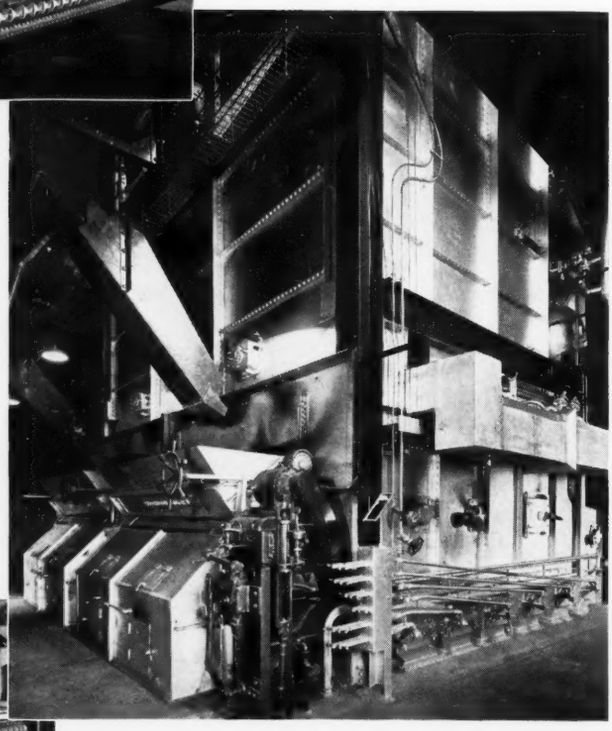
Saturated steam, pumped through the superheating coils, leaves at 2000 lb and 940 F. Some of this goes to the connected turbine, but the greater part goes to "evaporator" drums. Bubbling up through the water in these, steam loses its superheat and thereby generates additional saturated steam equalling the amount of superheated steam consumed by the turbine. Total saturated-steam output of the evaporators is then repumped through the superheaters. The circulating pump operates under full steam pressure, but with a small pressure differential.

A high-pressure boiler-feed pump delivers feedwater through the economizer to the evaporators.

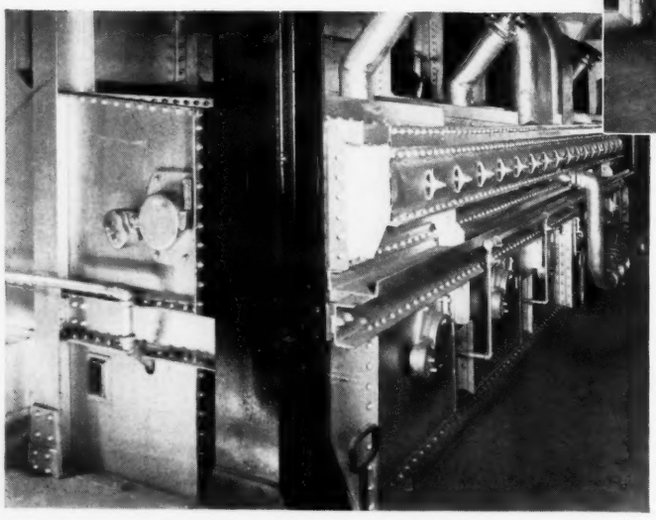
The RILEY Steel Casing - far



← Note excellent design and construction of roof casing of this 160,000 pound Riley Boiler Unit. Positive metal-to-metal connections between roof and wall casings insures air and gas tightness.



→ Side, front and rear walls are encased in Riley air- and gas-tight casing. Note close spacing of bolts holding casing panel flanges together, assuring permanent air- and gas-tight joints. To obtain a tight joint, flanged panels with close spaced bolts must be used. Note also heavy vertical reinforcing strips between casing flanges and also the rugged buckstays. This heavy construction prevents warping and twisting of casing.



← From basement to boiler roof, Riley employs the same excellent design and construction. Heavy strips welded to water wall headers are bolted to flexible seals, affording positive metal-to-metal seals along headers.

TRADE MARK Rx REGISTERED

RILEY

STOKER CORPORATION, WORCESTER, MASS.

Boston New York Philadelphia Pittsburgh Buffalo Cleveland Detroit Tacoma Baltimore Milwaukee Denver
St. Louis Cincinnati Houston Chicago St. Paul Kansas City Los Angeles Atlanta Memphis New Orleans

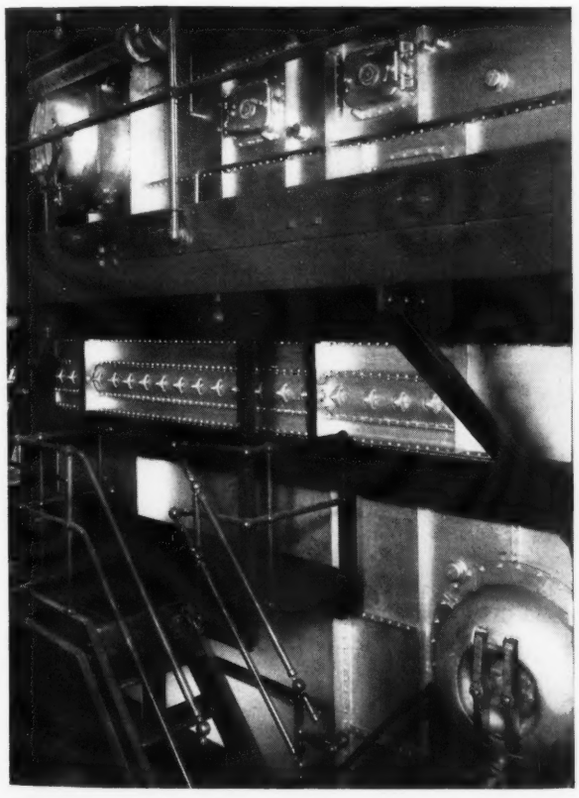
It will pay you to visit modern Riley Installations

more than an excellent appearance

The steel clad setting furnished with Riley Boilers is air- and gas-tight and remains tight after years of operating service.

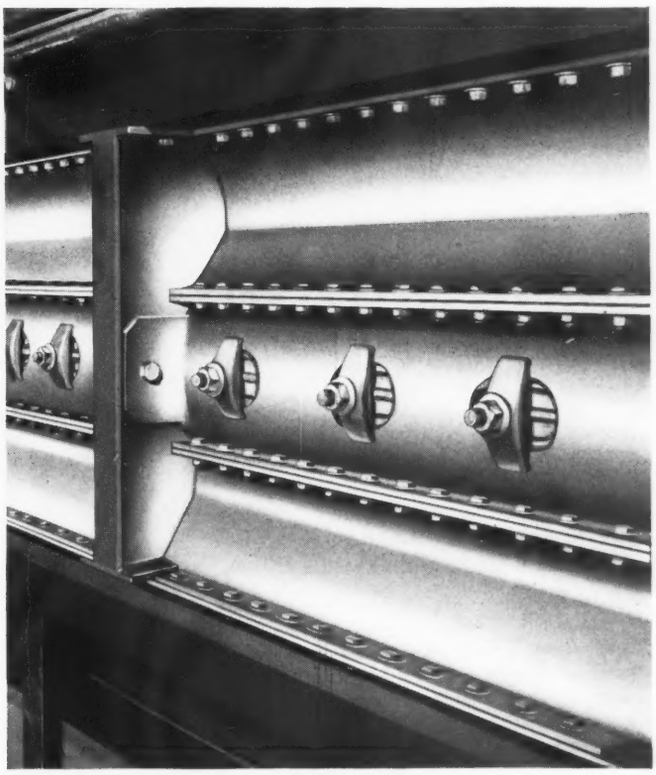
The Riley Steel Casing is furnished with Riley Steam Generating Units not only because of its excellent appearance but also because it assures a permanently air- and gas-tight closure. The use of flanged panels, bolted together with bolts on 3" centers, not mere batten strips, the use of flexible seals at water wall headers, the use of effective seals at the drums, result in a tight closure which stays tight after years of service. Users of Riley Units know this to be a fact. Investigation of a number of Riley installations will also convince you of this fact.

The excellence of design and construction of the Riley Steel Clad Setting is directly expressive of the correctness of design and construction of each item making up the complete Riley Steam Generating Unit . . . a design that gives extraordinary results and reliability.



Effective seals are provided around drum ends. Flexible metal-to-metal air seals are furnished at water wall headers to permit movement of headers without affecting tightness of joints between headers and casing.

Close-up view showing casing construction along water wall headers. Note flexible metal seals between header and buckstays . . . also note close spacing of casing bolts.



A survey of your power plant by a consulting engineer will possibly show ways of making surprisingly large savings in power costs

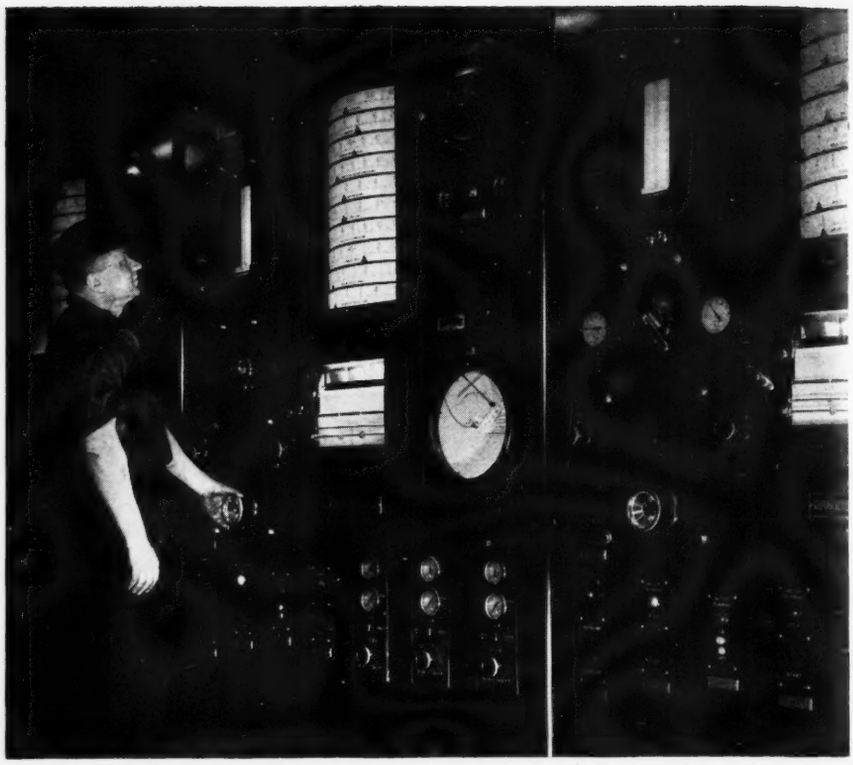
COMPLETE STEAM GENERATING UNITS

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • AIR HEATERS
ECONOMIZERS • WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • FLUE GAS SCRUBBERS

before purchasing Boiler or Fuel Burning Equipment

Brewery Power

Here are additional pictorial highlights of the Jacob Ruppert power plant described on pages 58-61



Fireman Anthony Domkus stands at master control panel for No. 2 boiler, with similar panels at each side for other boilers. Supermaster control board is at right, outside picture

Modern switchgear plays its part in insuring reliability. This section of board, in plant basement, mounts low-tension breakers and disconnectors, controlled by pushbutton on main switchboard in turbine room, above

Two compound-cyclone dust collectors on boiler-house roof handle flyash from three boilers. Conveyor and coal bunker can be seen at rear

THE OPERATING ENGINEER

George Edwards
Advisory Editor

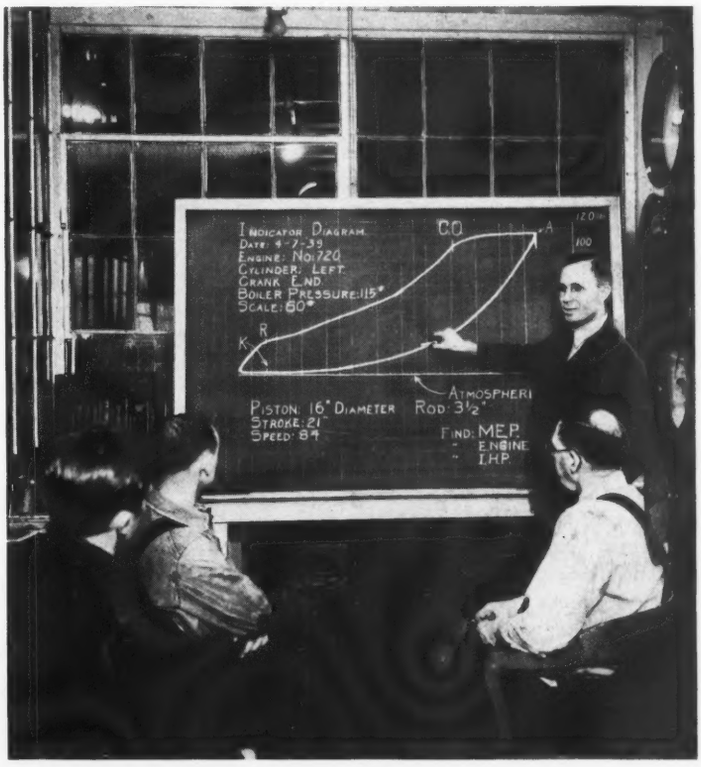
Practical Aids
Maintenance Hints
Questions — Answers

Published monthly as an integral part of POWER

Power Men Go to School

No hickory stick in this school conducted by chief operating engineer of a midwest metal-working plant. Voluntary attendance holds up year after year. Results make plant life worth while for all concerned

By CONWAY PIERCE
Chief Operating Engineer
Wyman-Gordon Co, Harvey, Ill.



Chief Conway Pierce demonstrates steam-engine compression, while Frank Marsh, Russell Snyder and C Onyon (left to right) get ready for an argument

THREE YEARS AGO our plant faced the problem thousands of others are facing—little plants and big, all across the country—how to get rank-and-file power-department workers better trained for their jobs.

Big plants have gone after this problem in a big way. For years some of the large industrial organizations have concentrated on the scientific selection and training of men, on proper placement and the weeding out of the unfit. The results have been worth the trouble.

Naturally the smaller plants can't afford the overhead to do the job that way. Often as not they just throw up the sponge as far as any systematic training is concerned. They simply put it up to the employment department to select the right men in the first case. And often the properly trained men are not to be found, or the employment department hasn't the capacity to classify applicants.

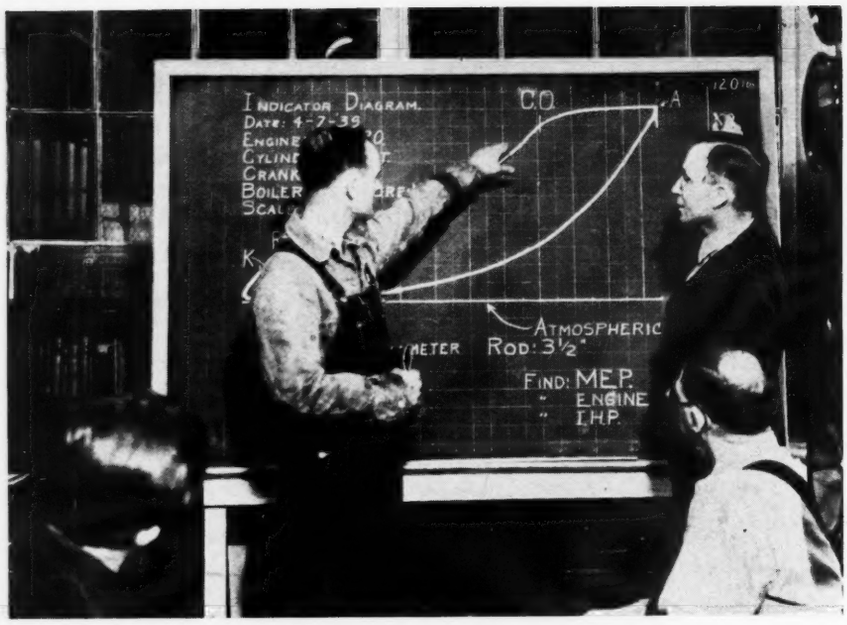
In my opinion, based on personal experience, the small plant has got to bring the school room right into the plant to get the best operating results. The chief difficulty will be to get the right teachers, rather than to find men willing and able to learn.

Some question whether subordinate workers are interested in learning. I say they are, given half a chance. A lot of them spend hard-earned cash for any book they think will be really helpful. I know for a fact that many spend long hours in study and drive miles to attend evening classes.

From the small-plant angle, the chief obstacle to good classes is the cost of outside instructors and the fact that the "natural" instructors of the group —the foremen and department heads —are already overburdened with work.

Yet the power engineer or the plant engineer can find a way if he is sufficiently interested. If he does the job right his better trained men will save him more time and trouble during working hours than he devotes to class instruction.

To get down to brass tacks, let me tell what we have been able to accomplish along this line in the power department of a medium sized middle-



"How about that cut-off?" demands watch-engineer Snyder

west factory, fabricating metal parts. We have 25 men in our department.

We got serious about this matter three years ago, studied and rejected plan after plan until we found one simple and practical enough to meet our needs.

As the starting point we selected a set of well-written power text books with plenty of illustrations. We organized a class to meet once a week. One of the supervisors acted as instructor. We made my office the classroom, because it was convenient to each member and because my books and catalog files were handy for reference.

The only special class-room equipment is a portable blackboard. Outside the class room is a bulletin board upon which are posted notices, detail views and parts lists of equipment—also printed instructions for the care and operation of various equipment.

This bulletin board does a real educational job—shows the men the "insides" of the machines they operate. And all the operating force see it whether they take our course or not.

We believe that technical reading should be encouraged, so keep engineering magazines available in the office. Each man is invited to use this material as he sees fit as long as it does not interfere with his work. The company subscribes to some of the magazines; class members donate the rest. Like the bulletin board, this service attracts a few men who don't care to attend classes.

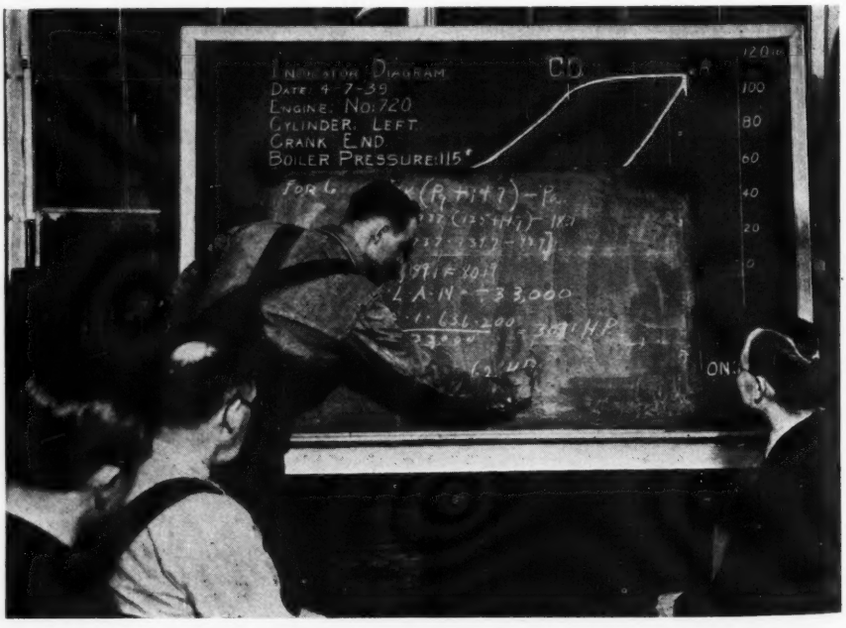
One rule we observe in this service is not to cheapen this branch of training by offering promiscuous free magazines whose principal object is to advertise some line of merchandising. If we see a particularly good article in one of these papers, we make an exception and mark the article for attention.

Many of our friends warned us that our class would die out in a short time, but it didn't and is going stronger than ever today after two years' operation. Attendance is strictly voluntary. One man drives 13 miles to evening class and is mighty regular about it. The others often deny themselves various pleasures in order to keep up with the class instruction.

We plan our program as a series of courses that will require several seasons. Work each year starts in September and runs eight or nine months.

One course deals with boilers and boiler-room equipment. This covers furnaces, firing equipment and com-

So many times, a little training saves a lot of later grief and misunderstanding. That's why we asked Chief Conway Pierce to tell how he trains his crew. You may want to use models or just plain paper instead of a blackboard; you may want to call in outsiders who are specialists—or build up somebody in your own outfit into one. Or you may want to cooperate with other local chiefs in a combined school. Go to it! Do it your own way, but don't miss the basic idea. It's sound. Knowledge, like a secret, isn't much fun unless it's shared!—GEORGE EDWARDS



"Okay, Russell, that's the way to turn P-L-A-N into horsepower"

bustion. We study sources and nature of fuels and their use. We study and discuss boilers of all industrial types commonly used, with particular reference to their purpose and performance. Other subjects in this course include piping systems, ash-handling equipment, safety and economy.

Steam engines are the subject of another full-season course. We get behind the actual engine into physics, thermodynamics and a little chemistry. I was surprised to find the men more interested in these subjects than in the engine itself.

A third course of study covers turbines and auxiliary steam-plant equipment and gives additional application for a lot of the science studied in the steam-engine course.

Naturally this theoretical work has to be tailored to fit the needs of the individual student, since the men come to us with different school backgrounds. Nor can we stick exclusively to book, pencil and paper. We use demonstrations and experiments to make clear the principles of science and particularly of mathematics.

The class is held one night a week, starting at 7:30. It runs to 9:30—longer when the interest warrants. A typical assignment will consist of 10 to 15 pages of text and one or two short references, plus problems to be worked at home and explained in class.

Problems come first in the class program, then discussion and explanation of the text. Experiments and demonstrations supplement the lecture period. What's left of the time is devoted to a quiz and discussion.

Practical Problems

Practical exercises add a lot to the interest. Right now, for example, the men are taking an indicator apart to see just how it works. Each has a chance to take a steam card (on a cross-compound air compressor with riding-cut-off steam valve). Each man takes his own card home to figure mean effective pressure by ordinates. Then he figures the engine constant and works out the horsepower corresponding to his card and the speed.

A while back the class opened up a simple vertical engine and analyzed all the "events" by watching the motion of piston, crank and valve while turning the flywheel slowly.

In physics the men got interested in vapors and in cooling by evaporation. So we blew air over some ether in a watch crystal and froze a few drops of water beneath it. Such demonstrations help make ideas stick.

It's made clear to the men that this education is not a one-sided deal. It is not our idea to train them narrowly for one particular job in our particular plant. We give them a broad training in power-plant operation. The course gives them a feeling of security based on knowledge, and loyalty based on security. Knowledge also insures interest in the job—makes the daily grind fascinating.

Not all of our power-department men take the course, but not one of them can completely avoid being affected by it. The men who attend the classes grow enthusiastic about their studies—talk about them at lunch and during working hours. Away from the plant this conversation spreads to the workers in other factories.

In the beginning this work was something of a burden (though an interesting one) for the supervisors who acted as teachers. In the long run, nothing has been added to our labors. Life is a lot more pleasant when the men under you work with understanding and interest, when they cooperate, forestall mistakes and need less supervision. Emergencies and late hours are less common than heretofore. Everybody feels better.

Our school plan is simple and practical. We don't award diplomas or demerits. We don't look for experts or wonder engineers. We made a plan to fit our needs and are getting worthwhile results.

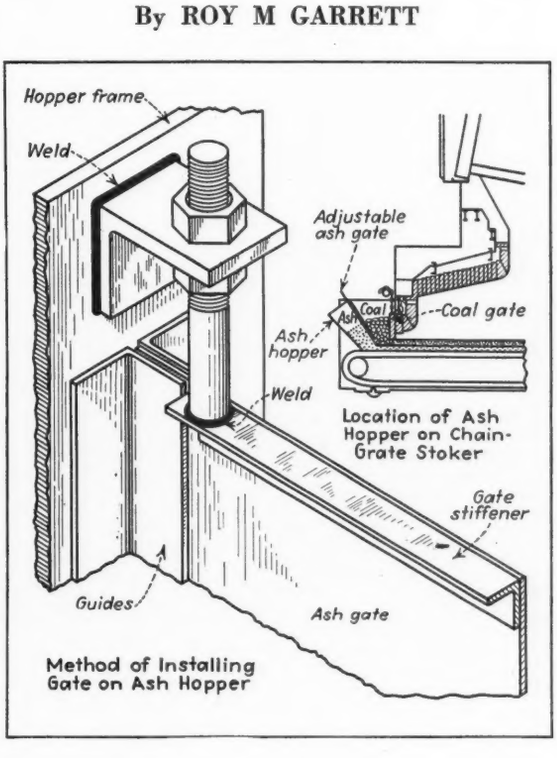
Feeding Ash Protects Chain Grate

By ROY M GARRETT

EXPERIENCE SHOWS that chain-grate stokers work best with high-ash coals, as ash protects grates from burning and so keeps maintenance down. For this reason, many operators of chain grates pass up real coal bargains because ash content is too low. However, such coal can be burned satisfactorily on chain grates—here's the way one plant does it.

Five 5060-sq-ft boilers, with natural-draft chain-grate stokers, run at ratings varying from 100% to 175%, averaging 150%. For ten years they've burned Eastern high-volatile nut and slack coals ranging from 4.5 to 9% ash, and even with the 4.5%-ash coal, they've had no operating trouble and little grate maintenance.

The secret lies in a second hopper and gate in front of the regular coal hopper, arranged to spread a layer of ash 1 to 3-in. thick directly on the grate under the coal. Diagram shows general scheme. Ash keeps grates cool, with no buckling, which all adds up to low maintenance. No trouble comes from added air resistance of ash layer, as 175% rating can be carried on only 0.5-in. natural draft over the fire. Running ash through furnace a second time lowers final loss of combustible in refuse.



Once operator finds right depth of ash layer, he rarely needs to change setting of ash gate and so doesn't need more flexible gate control. Making ash hoppers narrower than grates, by about 6 in. on each side, prevents forming clinkers at side-walls.

Shoveling siftings directly to ash hoppers meets part of ash needs but rest comes from overhead bunker. A partition divides ash from coal.

How to Charge an

AMMONIA SYSTEM

IF LARGE AMMONIA SYSTEMS were like sealed kitchen units, operating engineers wouldn't have to worry about charging. But life isn't that simple; leaks waste ammonia, or oil and water find their way in, so the operator must constantly check quantity and quality. When ammonia gets low, he must add it, and when charge gets too impure, he must draw it off and replace with fresh ammonia. Like all other jobs around the plant, there are right ways and wrong ways to charge ammonia systems; here are pointers on the right way.

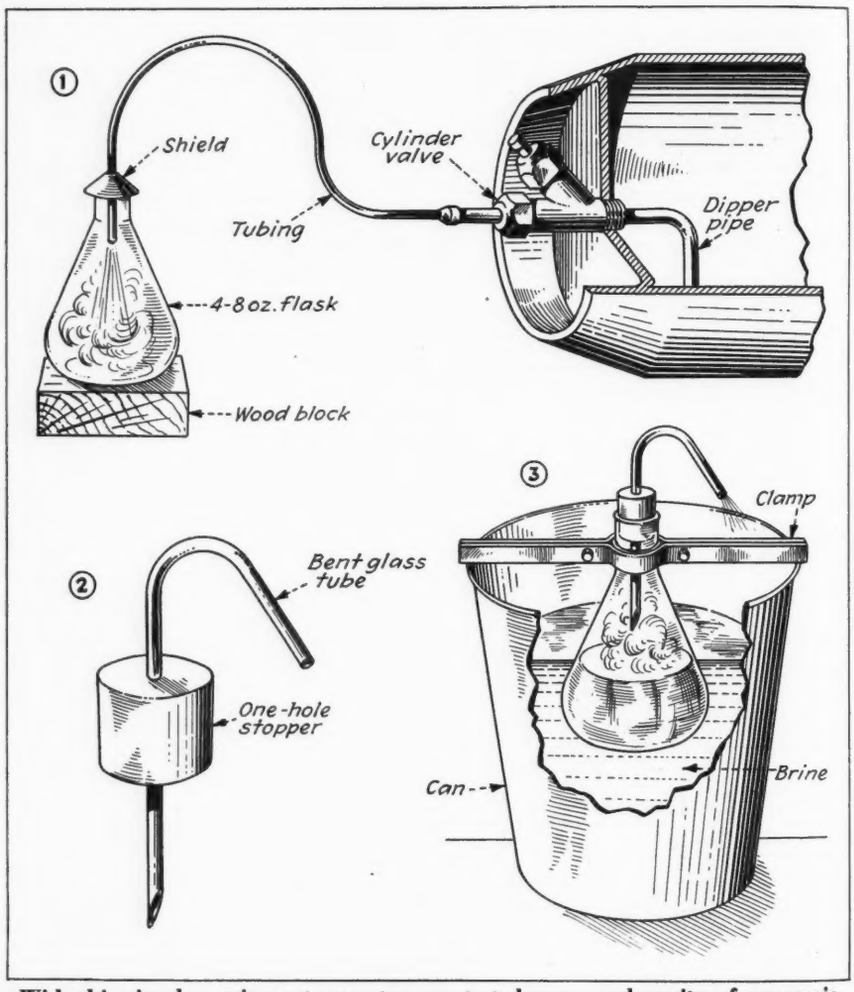
Manufacturers ship dry (anhydrous) ammonia in steel cylinders, holding 150, 100, 50, and 25 lb net. Regardless of size, liquid ammonia fills only 85% of cylinder, at 70 F. Extra space allows for expansion of ammonia at higher temperatures, say up to 125 F. Cylinders will stand normal expansion of ammonia but not powerful forces built up when exposed to high temperatures. Keep cylinders away from steam lines, hot exhaust pipes, and heating devices, and never apply a torch.

Take Care of Drums

Makers of ammonia test cylinders regularly to be sure they can stand high pressure and that rough handling and rust haven't made them too weak for safety. Operators can help by emptying drums as soon as received and returning them promptly. If necessary to store, keep indoors, never outside in direct sunlight or on ground where moisture will start rusting.

When a cylinder arrives, weighing comes first, followed by testing. Makers of ammonia guarantee both quantity and quality; to be sure, check both—it's easy and worthwhile. Weigh cylinders with protecting cap off, before and after emptying. Check gross and tare weights against shipping tag.

Luckily, the best test for dryness and purity of ammonia is also the simplest. With reasonable care, and nothing more than a small flask (4–8 oz.), one-hole stopper, and sampling pipe, you can duplicate accuracy of manufacturer's tests. Sketch shows details; sampling pipe can be tubing as shown, or ordinary black pipe, but must be clean. Fitting a shield (of metal, wood or cardboard) near the end will keep impurities out of flask when filling.



With this simple equipment operator can test dryness and purity of ammonia

Place cylinder in horizontal position with dipper pipe pointing down (valve outlet or stem will point upward, depending on type of valve). Open cylinder valve slowly to allow first gas and then liquid to flow, sweeping impurities out of sampling tube. Stand flask under tube with mouth against shield, as shown, and let in about 3–4 oz of ammonia. Remove flask quickly and cap with one-hole stopper, fitted with glass tube bent as shown (2).

Chief trouble with test comes from knack ammonia has of picking up moisture. Leaving flask open even for a short time picks up a surprising amount, so concentrate on closing flask quickly. Tube in stopper, which carries away gas during evaporation, points down so frost collecting at mouth won't

fall back into flask. Finally, it's best to avoid testing on humid days, as water in flask at start may be enough to make test worthless.

Ammonia will evaporate if flask stands in open air, but frost collects on glass and slows down evaporation. Hanging flask in can or bucket of brine by some simple clamp (3) or holding under stream of tap water does a better job. A low-temperature bath gives more accurate results—shouldn't be much above 32 F.

After ammonia evaporates, dry outside of flask and look at what's left inside, if anything. Water will show as a single drop at bottom or a lot of tiny drops. Oil may show as a film or a small puddle. Reject cylinder if slightest trace of oil or water is found. After checking for oil and water, wave flask gently through air to sweep out ammonia gas, then cautiously smell flask. A nauseating odor points to pyridine, an organic impurity.

So much for tests—99 times out of a hundred, or better, ammonia will be found pure and you're ready to charge. Most large plants take liquid ammonia through a connection between "king" valve and expansion valve. Connect cylinder to this point, as shown in (4). Purge valve helps but isn't absolutely needed. Raise bottom end of cylinder about ¾ in., and be sure dipper pipe points down.

If charging line and connections are tight, close king valve and open cylinder and charging valves. After closing king valve, pressure between it and expansion valve will drop to suction pressure, allowing liquid ammonia to flow into system. To be sure cylinder is discharging into system, put it on scale and watch change in weight. As cylinder empties it gets cold near valve due to evaporation of last few ounces of liquid, and if scales aren't handy this will show emptying. Don't depend on it, however—always weigh cylinder after charging, to be sure it's empty. Sometimes a mistake in hooking up equipment or some other trouble causes reversed flow—from system to cylinder, overfilling it. Exposing such an overfilled cylinder to even slight overheating might bring on a dangerous explosion—better be safe than sorry.

When cylinder is empty, close cylinder and charging valves and open king valve. Bleed pressure from charging line through purge valve, if installed, or crack union carefully.

Charging With Gas

To charge a system with gas, instead of liquid ammonia, turn cylinder over so inside dipper pipe points up. Ammonia may be taken from cylinder at about 1.5 to 2 lb per hr; heating cylinder with warm water will speed up flow but isn't recommended. Always check that gas flows *out* of cylinder and doesn't condense into it. Weighing cylinder before and after will do the trick.

How much ammonia should a system contain? For the first charge or a complete recharge, best answer comes from engineer who designed and installed system. If figure isn't handy, operator can calculate amount needed from data given in refrigerating handbooks. In a running plant, gage glass on receiver tells the story; receiver should be about ½ full. Without gage glass, operator has to fall back on watching operation. If only lower coils frost when expansion valve is wide open and plant isn't overloaded, system needs ammonia. If clicking sound is heard in expansion valve, it checks lack of ammonia.

[*For pointers on charging other refrigerants, and operating plants to get most out of them, look for articles in future issues of "Operating Engineer". Data for this article was furnished by National Ammonia Division, E I Du-Pont de Nemours Co, Inc, and Henry Bower Chemical Mfg Co.*]

✦ ✦ ✦

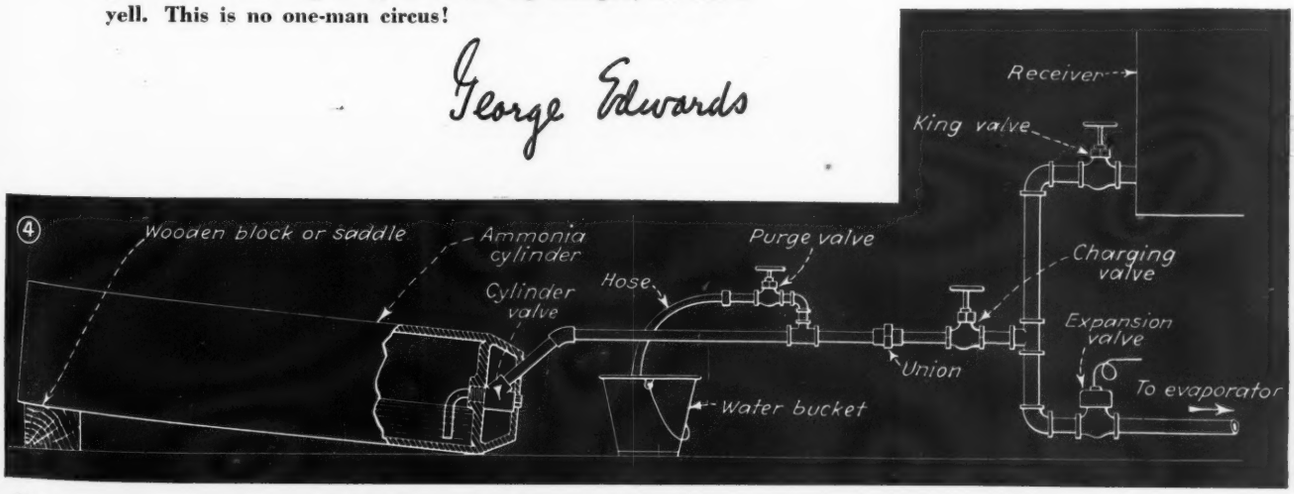
MOTHER AND CHILD DOING FINE

Well, here's our baby in his second month. I hope you'll all like him as well as you did at first. Judging by the letters I've gotten, "The Operating Engineer" has been needed for a long time. Of course, we aren't dead certain just where we're going yet, but I was a year and a half old before I could walk myself, so you can't expect too much for the second month.

Anyway, we've got a pretty good mixture here. In addition to that school article up front, there's a half page on feeding ashes to protect chain-grate stokers, and "How to Charge an Ammonia System". This last is the first of a series on refrigeration, something a lot of you have requested. Also, another batch of practical ideas, some questions and answers, a lesson from Phil Swain on figuring areas, and a swell page of pictures on how to seize wire rope before it seizes you.

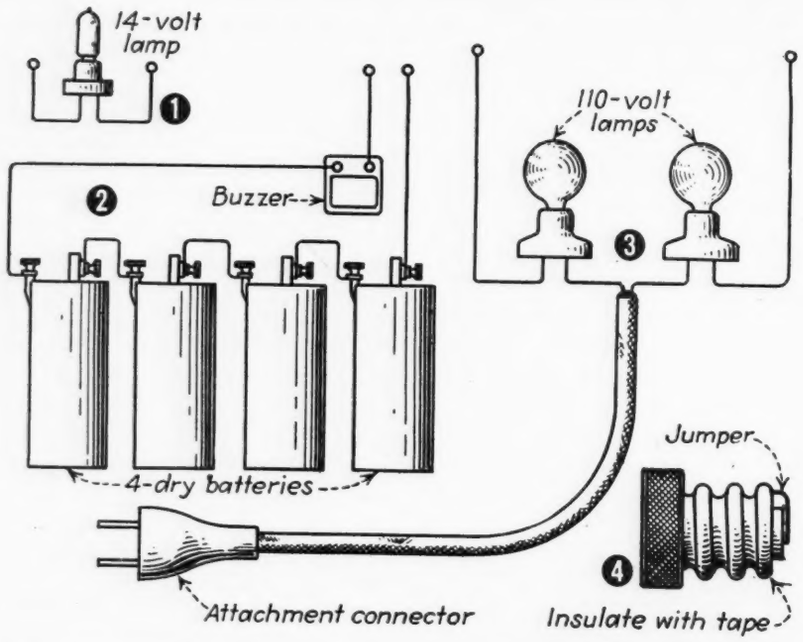
Remember what I said about this being your baby too. If you want something here, or something changed, let out a yell. This is no one-man circus!

George Edwards



Most common arrangement for charging liquid ammonia; charging connection between "king" valve and expansion valve

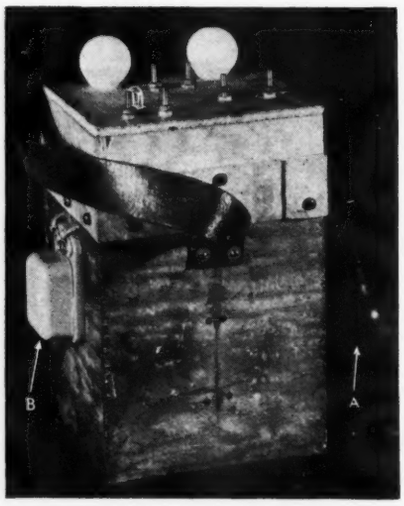
PRACTICAL AIDS TO OPERATION



All-Purpose Test Box

PORTABLE TEST BOXES are almost legion, but here's one (see photo) that will do all the testing required in elevator-maintenance work. On top are 6 terminals and 3 small lamps. Two of these terminals connect to a 14-volt lamp, Fig. 1, and are used to test the 14-volt signal system. Four dry batteries in the box and a buzzer, *B*, outside, are connected in series and to two terminals on its top, Fig. 2, for ringing out circuits where no other means of testing are available.

The two 110-volt lamps connect to an attachment connector *A* and to two terminals at the top of the box, Fig. 3. These lamps can be used in any one of several ways. The attachment connector may be connected to an extension cord and plugged into a 110-volt outlet. Then, with two leads from the terminals, a 110-volt circuit is available for testing dead circuits. A short-circuiting attachment plug, Fig. 4, may be put onto the connector. This completes the circuit through the lamps to the two terminals, from which two leads may be taken for testing 110- and 220-volt live circuits. After the attachment plug, Fig. 4, is short-circuited,



it should be insulated with tape to insure against grounding.

New York, N. Y. CHARLES J ELTER

Cleaning Oily Belts

AN INEXPERIENCED OILER flooded the bearings on a line shaft and soaked a large leather belt with lubricating oil. Before long, the belt began to slip and run off pulleys. We washed the belt with gasoline and wiped it thoroughly, cleaned the pulleys in the same way, and drew the oil down to the proper level in the bearings. This treatment improved operation, but it did not entirely correct the trouble, so the belt was again washed with gasoline and wiped.

Oil continued to work to the surface so we sprinkled Fullers earth on the belt while it was running without load until both sides were thoroughly coated. After operating this way for about 1 hr, we stopped the belt and scratched off the earth, which had soaked up oil from the belt. Another washing with gasoline and a treatment with a belt dressing restored the belt to good operating condition.

Sometimes prolonged application of lubricating oil to a leather belt will cause the plys to separate. When this happens, the joints should be opened, scraped and reglued in the proper manner. This job should be done only by an experienced belt man.

Sayreville, N. J. R B HUMPHERY

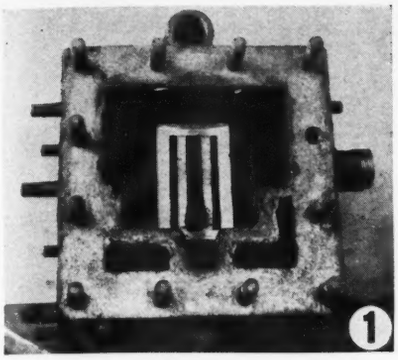
Worn Seat Rejuvenated, Saves $200

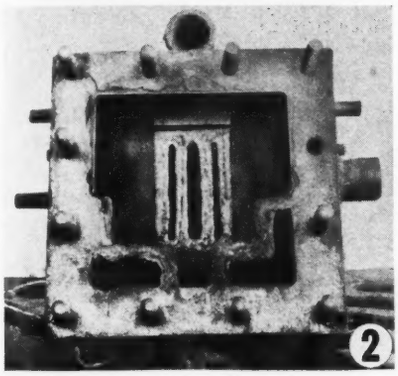
WORN CAST-IRON SLIDING SURFACES may be built up by arc welding and remachined to a true surface, thus saving cost of a complete new part. Example pictured is a slide valve salvaged at McNally Pittsburg Manufacturing Co, Pittsburg, Kansas. Information was supplied by the Lincoln Electric Co, who furnished the electrodes for this job.

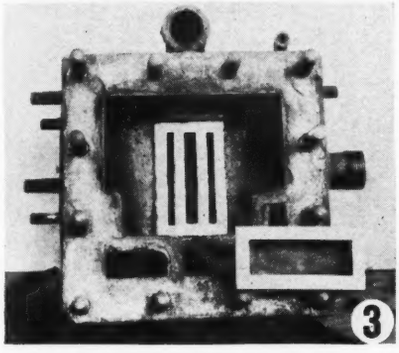
Fig. 1 shows the worn seat "as is", Fig. 2 after building up with weld metal and Fig. 3 after final machining. This repair saved McNally Pittsburg approximately $200 replacement cost.

The electrode used deposits a soft machineable alloy which bonds well with the cast iron, but with a minimum of penetration or heating of the base metal. The deposit may be machined, sawed, drilled or tapped without difficulty.

The welding is done with just high







enough current to obtain the necessary bond. Operator holds a fairly long arc (about 1/8 in.) and weaves electrode slightly from side to side. Average conditions at the arc are 90 amp and 18 volts. Don't let casting get too hot. Weld intermittently in short beads, 2 or 3 in. long. Peen each bead after depositing.

Desk Fan Does the Freezing Job

WE HANDLE the cooling load in our cold-storage plant with a 5x5-in., 2-cylinder constant-speed ammonia compressor, and the freezing load with a 3x3-in. compressor of the same type. The plant operated satisfactorily under normal load conditions, but trouble developed when 10,000 to 20,000 lb of pork, more than the plant was designed for, was put into the freezer. To cure the situation we paralleled the compressors, but the compressor capacity was then far in excess of that of the cooling coils. Freezing was still slow and something had to be done to increase cooling-coil capacity.

To do this we installed a common oscillating desk fan on a piece of board wedged in between the cooling coils. We unscrewed all lamps from their sockets and plugged the fan into one socket. Remote bulbs of the thermoexpansion valves were removed from the returns and allowed to swing freely in the air. Adjusting stems on these valves were backed off to the limit, throwing the valves wide open. To prevent accidental shutting off of the fan, with consequent danger of flooding the compressor, the light switch was locked closed.

With the fan circulating air over the cooling coils, freezer temperature was down to 6 F after 15 hr operation, 10 deg lower than that without the fan. The temperature then kept going down gradually at the rate of 2 to 3 deg per day until entire load was frozen.

Our experience with this fan has been so satisfactory that we now plan to install a permanent fan in the freezer and in each of the 6 coolers. The 6 coolers are supplied from the large compressor, so we plan to control each fan with a thermostat in the room with the fan. When a room reaches proper temperature its fan will be shut down to prevent subcooling.

Marissa, Ill. GEORGE BLUM

Rebuilt Burner Orifice Improves Operation

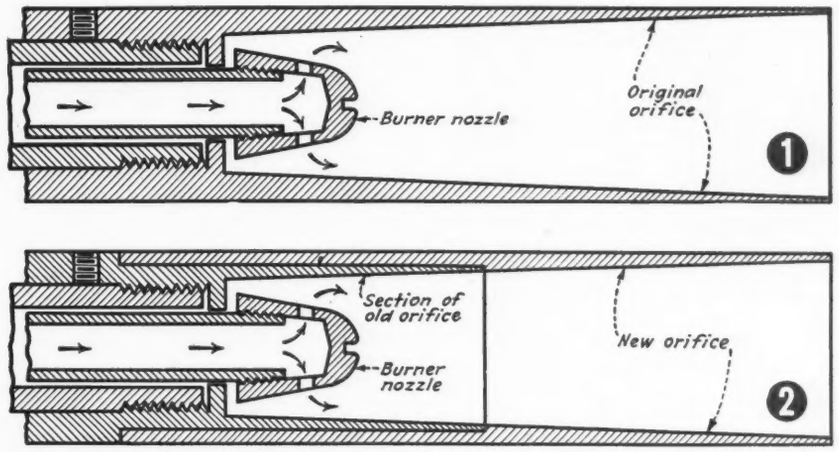
ON OUR HEATING BOILERS, rotating orifices in the oil burners were short-lived. The temperature was too high at the end of the orifice. Carbon formed on its inside, making frequent cleaning necessary. The end of the orifice was thin, Fig. 1, so that it wore out in a month from the frequent cleanings and high temperatures.

To prolong its life, we decided to make the orifice thicker at the discharge end. An old nozzle was sent to a machine shop and turned to form an inner section, Fig. 2. Then a sleeve was made from a piece of heavy brass pipe to complete the orifice and fitted over the old section with a press fit. Note that the discharge end is about three times as thick as in the old one. This improved orifice is good for a whole season's operation, instead of one month of service from the original design.

Originally the flame impinged upon the sidewalls and caused quite a bit of refractory trouble. Making the discharge end of the orifice thicker has reduced the diameter of the flame somewhat, and the flame is also carried farther into the furnace.

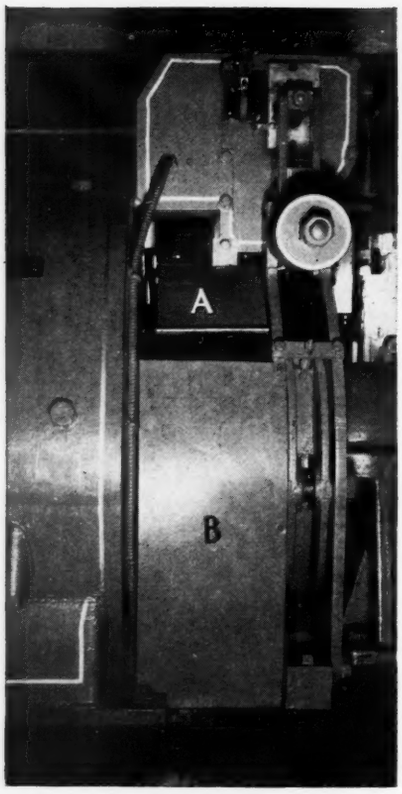
These small changes have eliminated our refractory trouble; boiler and furnace efficiency is at least as good as before the change was made.

New York, N. Y. A HONORE
Chief Engineer, Whitehall Hotel



Dust Stops Makes Cleaning Easier

ONE WAY TO KEEP A PLACE CLEAN is to keep dirt out; this is what we did in the McGraw-Hill Building elevator machine room. Natural draft up the car hoistways, and movement of the cars, caused a strong draft of air up into the machine room. This always carried more or less dust that was deposited over everything. To keep most of this dirt from getting into the motor room, we placed sheet-metal guards around the traction sheave as at *A* and *B* in the photo. Now most of



the dirt that comes up the hoistway falls into the machine base or is caught on the guards where it can be easily cleaned periodically.

New York, N. Y. FRANK SCHLEIFF

Penetrating Oil Handy Maintenance Tool

PENETRATING OILS are ordinarily thought of as agents used to eliminate squeaks and crickets from automobile springs. Their ability to work into and lubricate spaces which have extremely close clearances, to penetrate and break up rust accumulations, and to dissolve tars and similar deposits makes these oils a very helpful tool for any plant-maintenance crew.

A penetrating oil can be used to free nuts and other close fitting parts subjected to heat. Apply at strategic points immediately after equipment has been removed from service, so that the oil can do its work during the cooling-off process. This will make disassembling easier.

Penetrating oils applied to cold parts must be given time to enter the joints they are intended to loosen and are most effective when used at least 12 hr before starting work. For applications of this nature, where there is little chance of the oil catching fire, mixtures containing volatile solvents can usually be employed with safety.

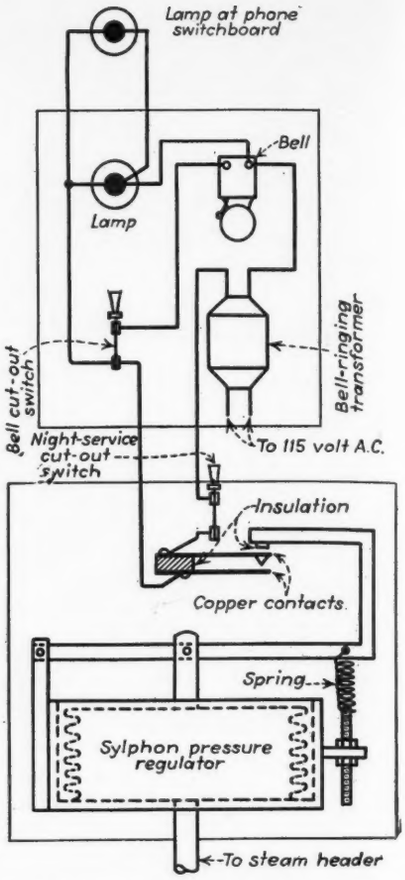
Roanoke, Va. S H COLEMAN

Bells on Steam Pressure

BELLS ARE OKAY ON CATS, also on heating systems. The sketch shows how we did it. First, we connected a discarded sylphon-type pressure regulator in the steam line and rigged it to close a pair of electric contacts to ring a bell and light two lamps when the steam pressure drops below 5 lb. We mounted one bell and one lamp near the regulator and the other lamp near the telephone switchboard, where an operator is on duty all the time.

If the oil burner fails to keep up steam pressure, the bell rings and the lamps light. When an attendant answers the signal during the day, he first opens the cut-out switch to stop the bell ringing. At night, if the lamp at the telephone switchboard stays lighted more than two or three minutes, the operator starts trying to get an attendant on the telephone. By sounding the signal when pressure drops to 5 lb, we have plenty of time to correct the fault before someone complains about a lack of heat.

To economize on fuel oil and also to prevent too frequent cutting in and out of the burner, we adjust it for smaller flame on warm days than on cold. If outside temperature drops suddenly, the burner may not be able to supply enough heat. When the pressure drops below 5 lb, the alarm sounds and an attendant adjusts the burners for a larger flame.



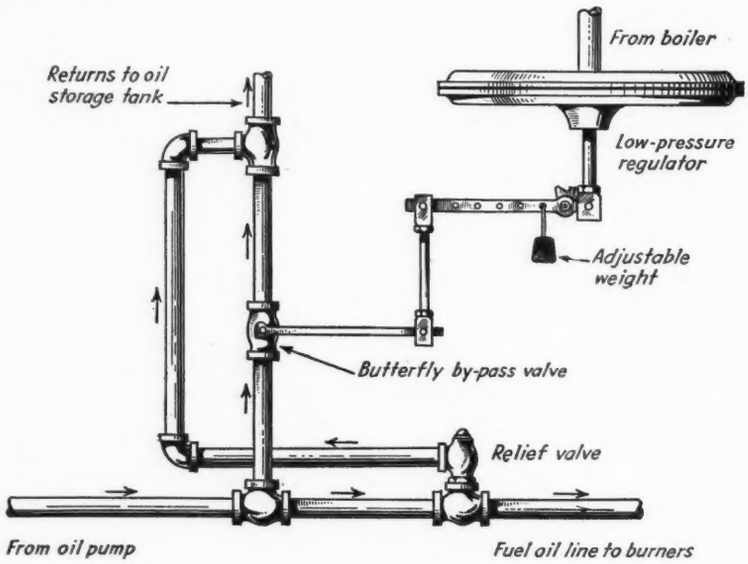
This simple signal system permits us to operate the boiler economically and also insures that it is being operated to give first-class heating service.

New York, N. Y. A HONORE
Chief Engineer, Whitehall Hotel

Oil-Burner Control

A NUMBER of efficient oil-burner regulators for low-pressure heating boilers are available at reasonable cost. However, the engineer of one plant found himself with a supply of good second-hand equipment but with no money to buy a regulator for the boilers. Possessing plenty of Yankee ingenuity, he assembled the rig shown.

Two major items were a diaphragm-type regulating valve formerly used in a vacuum system and a 1-in. high-



pressure butterfly control valve. Diaphragm chamber was piped to the main steam line from the boiler. Butterfly valve was installed in a line teed off from the pump-burner piping and feeding back into the oil-storage tank.

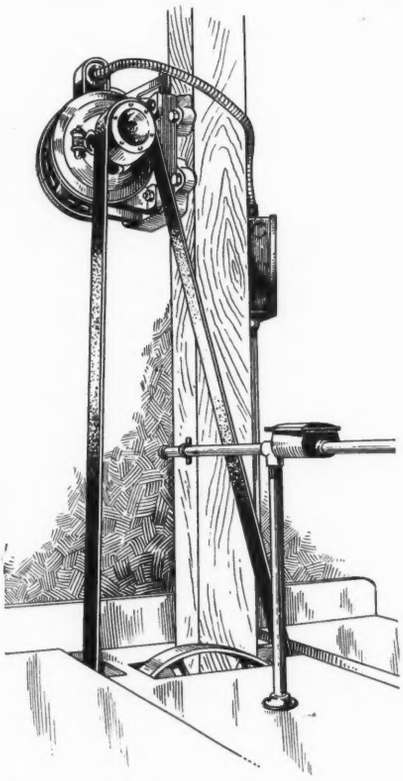
Lever arms, in linkage connecting regulator and butterfly, were adjusted to keep butterfly open just enough to prevent unstable ignition at the burner when regulator was in closed position. Position of weight on lever arm was set to maintain desired pressure.

Operation of this regulator has been very satisfactory; it holds steam pressure practically constant and shows a distinct saving in fuel.

Canton, Mass. HARRY M SPRING

Clean-Cut Motor Installation

OUR NEW shoe-stitching room has 40 stitching tables. Drive of machines at each table is by an under-table ball-bearing countershaft belted to 1- or 1½-hp motor. For most effective



drive, and to keep room neat, clean and safe, motors are mounted on the building columns alongside tables.

Motors are high enough to give ample belt length. For best operation, motor pulleys are full 4-in. diameter and leather faced. Pulley face is 4-in. wide with 3½-in., single-ply, oak-tanned leather belt. To insure good and less frequent lubrication, transparent oil reservoirs are installed on all motors.

Brockton, Mass. H A F CAMPBELL

Double Locks on Elevator Doors

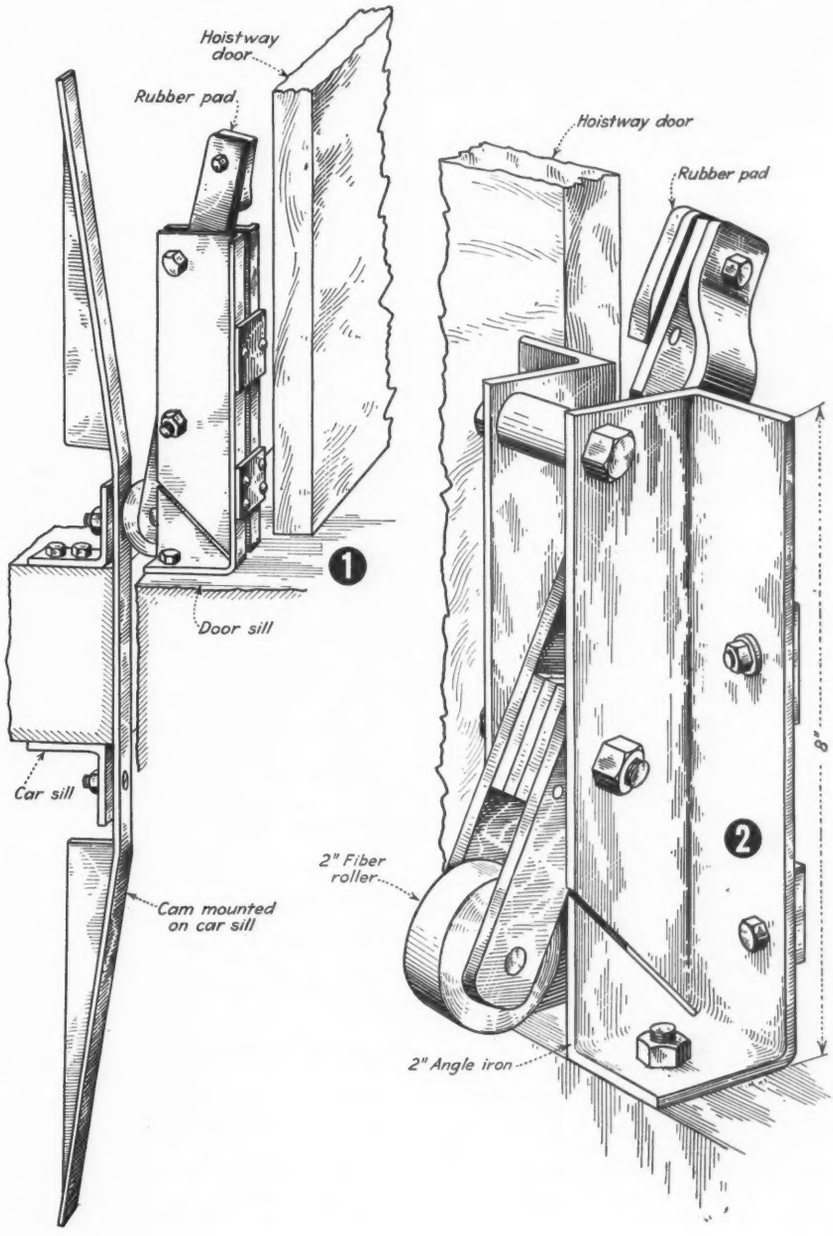
STRANGE AS IT MAY SEEM, there are several cases on record where elevator mechanics and others have used the emergency key to open elevator hoistway doors and then walked into the open hoistway thinking that the car was at the floor. To make sure this won't happen in our building, we built and installed safety devices on all ground-floor hoist doors. If the car is not at this landing, the hoistway doors cannot be opened more than about 5 in.

This device consists of an arm pivoted between two pieces of 2-in. angle iron to form a stand, Fig. 2, that is bolted to the door sill. One end of the arm carries a 2-in. fiber roller and the other a rubber block. This arm is pivoted so that its top falls back of the closed hoistway door when the car is not at the floor, Fig. 2. When the car is at the floor, Fig. 1, a cam mounted on the car sill rests against the roller and holds the arm clear of the hoistway doors.

Now, the only way that the ground-floor hoistway doors can be opened when the car is away from the landing, is to first unlock them in the usual way. This allows opening the doors about 5 in. which, in turn, breaks the operating circuit so that the car cannot be started. Then, an attendant may put his arm in between the doors and release the safety with a stick. When he does this it is with the full knowledge that the car is away from the floor.

We purchased the fiber rollers. Otherwise, the devices were built with material available in the building.

New York, N. Y. FRANK SCHLEIFF



READERS' PROBLEMS

Questions for Our Readers

Kerosene for Scale?

Question 1

ON TAKING CHARGE *of a small plant recently, I opened three hrt boilers for cleaning and inspection and discovered heavy deposits of mud on tube sheets, back end of shell, and especially thick on rear flanges and seam covering rivets. Boilers were installed in 1917. The accumulation is rock hard, and I can see no way to reach it with hammer and chisel. In spite of the salesman's promises, a feed-treatment product failed to do any good.*

A friend of mine, who has operated boilers for many years, claims that a gallon of kerosene put in boiler with water treatment would get in back of deposits and force them away from shell. Regular use of kerosene has kept his boilers clean as new without doing them any harm. However, I'm afraid of getting any kind of oil in boilers so I'm not jumping at the idea. Can POWER *readers tell me if this is a good suggestion and if it isn't, how can I go about removing or dissolving this scale?*—FS

Defrosting Coils

Question 2

IN OUR *storage room we have two sets of direct-expansion ammonia coils. How can we arrange to defrost these coils by using hot gas?*—BES

SUITABLE answers from readers will be paid for if space is available for publication. Answers accompanied by practical drawings or photographs will command additional pay.

Sparking Oil Ring

Answers to May Question 1

The Question

WE HAVE *noticed sparks similar to static sparks whenever the oil ring in the outboard bearing of our turbine-generator comes in contact with bearing metal. An examination of this bearing shows its surface coated with a hard chocolate-brown deposit having numerous small pits that extend into the metal itself. What causes this trouble and how can it be remedied?*—SHC

Sparks Are Static

I AM FAMILIAR WITH PITTED BEARINGS such as SHC speaks of, and the sparks he refers to as like static, *are* static sparks. Some engineers claim pits in bearings come from acid in oil, but if you look at them under a microscope you'll see they're made by electricity jumping to ground. Rotor acts as condenser, discharging at intervals. Film of oil insulates rotor from ground at every point except where spark jumps.

Trouble can be overcome by fitting a brush to bear on the shaft itself or on a ring which is grounded to the shaft, brush holder being grounded to machine frame. If insulators separate frame and bearing support or end bell, remove them or connect a jumper across. Grounding the shaft is the main idea.

Cairo, Ill. A L ALBRIGHT

Test for Rotor Ground

I THINK SHC'S GENERATOR has a ground in the field rotor and, if so, he's due for some unwelcome fireworks if another ground occurs anywhere in the distribution system. Recently I had a case where a ground in the rotor of a 2000-kw unit caused current to leak through the center bearing, which showed pit marks along shaft similar to SHC's. Ground was found under end shield supporting coil ends; when unit was at rest no ground was evident; at 1040 rpm, a full ground showed between exciting rings and shaft; and at 650 rpm, ground disappeared again. In this case, we had to remove rotor and return it to factory, where end shields were taken off and a high potential applied to terminals of field winding to break down ground.

SHC can test for ground by removing brushes from exciting rings and applying a magneto between rings and shaft. Lacking a magneto, test can be made by connecting one side of 110-volt circuit to shaft and other side to exciter ring, with 110-volt lamp in one side of circuit. If no ground shows with unit standing, bring it up to speed slowly, with testing circuit in contact with shaft and exciter rings. If ground exists, lamp will light.

Plymouth, Mass. C B HUDSON

Check Stray Currents

IT LOOKS AS IF STRAY CURRENTS are passing through bearings of SHC's unit. These can come from faulty casting of yoke, improper arrangement of conductors coming out of machine, or improper arrangement of series field conductors in a machine to run in parallel with others. Blow holes cause faulty yoke casting, producing unequal flux distribution, but shouldn't be found in machine made by reputable manufacturer. As to conductor arrangement, place all negative conductors on one side and positive on other tends to set up induced currents that will flow through shaft. Unequal pole strength, due to shorted-out turns, might also cause the trouble. If stray current doesn't come from any of these sources, it probably comes from outside; only thing to do is run it down.

Best remedy is to trace stray current to source and correct if possible. When this can't be done, insulate the bearing pedestals and the oil pipes. It's a good plan to test pedestal after job is done to be sure there is no metallic connection between shaft and bedplate. Use a bell and batteries, a magneto, a test light or whatever is handy to make a continuity test.

Rosebud, S. D. ART WILLIAMSON

Blames Acid or Stray Field

SHC'S TROUBLE COMES FROM either galvanic action due to acid in oil, or stray fields. Most oils contain some slight amount of sulphuric acid when new; acid in hot oil sets up galvanic-cell action between two unlike metals. This causes a current to flow from shaft to bearing or, in other words, circulate around shaft and bearings.

If oil proofs low in acid, trouble probably comes from stray fields setting up a current which travels around machine. To remedy this, replace outboard-pedestal shims with micarta shims and ream holes in pedestal for holding bolts. Use micarta tubing to insulate bolts, with micarta washers under bolt heads. Dowel pins will also have to be insulated.

I advise SHC to get after this trouble at once, as he may be in for some costly replacements—possibly a new shaft or bearing.

Plainfield, N. J. H W HODGSON

Might be Ground

SPARKING OF OIL RING and brown deposit with pits in bearing metal point to electric current flowing in shaft—possibly a ground showing up only when machine is running, or possibly a current set up by magnetic forces. Assuming generator has been checked for running ground, use a milli-voltmeter to find strength of current from shaft to frame. Test will probably show negligible voltage, but enough to set up electrolysis between bearing and generator shaft. Brush of soft copper, carbon or similar good con-

ducting material, fastened to frame and in contact with shaft, should be best remedy. It would be a good idea to check all bonding connections on grounds.

The commutator end bearing on one of our single-phase induction-repulsion motors kept wearing out, and bearing showed small pits and dark brown coating. A fibre motor pinion prevented direct ground contact for shaft. A close check showed faint sparking at commutator on short-circuit device. Replacing short-circuit device gave better contact without any sign of sparking and ended bearing troubles.

Rockford, Ill. N W OMAN

Renew Pedestal Insulation

IT IS EVIDENT THAT SHC'S TROUBLE comes from stray current passing between shaft and bearing; color and pitting of bearing and shaft check this answer. Bearing pedestal at this point is insulated from base of machine. Oil may have soaked this insulation and destroyed its effectiveness, or some of piping going to this pedestal is not properly insulated. Renewing this insulation should cure trouble.

Hartford, Conn. R B SCAMMON

Paint May Cause Trouble

CURRENT LEAKAGE FROM BEARING to shaft is at bottom of SHC's trouble; insulation of bearing pedestal should be checked. Sometimes such trouble shows up suddenly after painting a generator. If this is case, it is only necessary to remove all paint from fibre insulating parts. If trouble has developed over a period of time without apparent cause, only remedy lies in removing and testing pedestal insulation, replacing all found faulty.

Saltville, Va. J C PORTER

Look for Flow Between Grounds

SHC'S TROUBLE UNDOUBTEDLY comes from a ground between generator field and rotor shaft and another ground on the field circuit outside of the machine, on some other dc circuit, or a return circuit close by. Between these two grounds, current flows through outboard bearing and possibly through other bearings also. Because of small irregularities in bearing surfaces, flow of current takes place at several points, where low-melting-point bearing metal pits. Arcing decomposes oil film, throwing down a dark-brown sludge deposit.

Apparently ground on generator field occurs near end of field winding and current to ground is relatively small, else abnormal voltage-field current situation would have warned of trouble. Megger tests, with field brushes up off collector rings, will show up grounds; generator field will read zero or low resistance to ground, and outside field circuit will likewise show low resistance unless second ground is in some other circuit, possibly field winding of another machine.

Megohm meter shows insulation resistance of machine—can be used to check ground in field

Remove cording, between two collector rings and winding, which holds field cables fixed in place on rotor. Wash cables and slots with high-volatile naptha mixed with carbon tetrachloride (to cut fire hazard) and dry thoroughly. Put field cables back, re-cord them in place, and paint with fresh, water-free shellac or insulating paint. When fully dry, megger again. Wash rotor thoroughly with naptha-carbon-tetrachloride mixture, using an air spray through ventilation holes in end pieces. Dry out thoroughly and megger again. If resistance to ground is same as before, rotor will have to be sent to manufacturer for reinsulating or rewinding. It's not a good idea to attempt this in the field.

These steps will clear up ground in generator rotor. Second ground should also be located and cleared; method will depend on location.

Port Arthur, Tex. F F AXTELL

Weak Insulation

SPARKING OF OIL RING in outboard bearing when it comes in contact with bearing metal can be caused by weak insulation between commutator ring and generator shaft. This condition can be checked by using a Megger between commutator rings and shaft.

Wilmington, Del. JOHN LUFFT

Leaking Tubes

Answers to May Question 2

The Question

RECENTLY *we retubed two Manning firetube vertical boilers. After the job was finished, we found so much oil on the tubes that it was necessary to clean them with soda ash to prevent foaming and priming. However, the boilers did prime before the oil was entirely removed. Since that time, the joints where tubes meet crown sheet have started to leak. Can this be attributed to foaming or is some other cause more likely?*—MCC

Blames Oil on Tubes

OIL ON TUBES caused them to overheat and tube-ends became loose in crown sheet as a result of linear expansion. Before installation, tubes should be thoroughly cleaned inside and out, tube-ends polished, and holes in sheet should be clean and smooth. This doesn't seem to have been done in this case. Insufficient rolling may also have contributed to trouble. All these operations should be performed by, or under supervision of, a skilled mechanic.

Remedy for leaks now is re-rolling tubes. If tubes or holes in sheet are badly misshapen, then it may be necessary to electric weld around neck of tubes, outside, after rolling.

Kearny, N. J. GEORGE MCNALLY

Oil Caused Foaming

MCC STATES THAT PRIMING occurred before oil was entirely removed from new tubes, therefore it appears that conditions leading to priming don't ordinarily exist in his plant but came from foaming caused by oil in boilers. Leakage most likely resulted from overheating of tubes before oil removal. Even slight overheating will frequently produce leakage in long tubes such as in a Manning boiler, and particular pains should be taken to avoid overheating when boiling out with soda ash.

Evidently no serious damage has been done in this case and satisfactory repairs can probably be made by re-rolling old tubes, if during recent retubing the rolling of new tubes was not carried beyond the point necessary to prevent leakage. Excessive rolling of tubes in original installation, with no allowance for light re-rolling that might be required, may considerably shorten service life of entire set.

Jersey City, N. J. I S CHAMBERLAIN

Boil with Caustic Soda

PRIMING IS A MECHANICAL LIFTING OF WATER by aspiration of steam flow; foaming is passing of steam bubbles which do not break to release steam on reaching water surface. This latter depends on surface or film tension and often can be traced to high concentration of solids, presence of organic matter, or oil.

Makers sometimes coat new tubes with "slush oil" to retard rusting during storage and transportation. Remove all oil possible by sponging with kerosene before installation. If tubes ends are welded, be sure to vent all kerosene fumes before welding. Before operating boiler, boil out at atmospheric pressure with a solution of about 45 lb of caustic soda per thousand sq ft of surface. Cool, blow empty, and flush out before refilling with clean water for operation.

Soda ash is not as effective as the caus-

tic treatment described before and it seems likely that some oil remains in these boilers and coats the crown sheets. Coating may be thin and difficult to detect, but a thin coating is often enough to cause overheating and distortion, followed by leakage. It is also possible, in MCC's case, that tube seats were scored in removal of old tubes. If so, a light bead of electric welding around each tube should make ends tight. Otherwise, it might be necessary to remove all leaking tubes, ream tube holes, and install new tubes with ferrules.

Other possible causes of trouble are insufficient rolling of tubes or defective tubing. Neither seems likely since the Manning boiler is quite accessible and tubing runs extremely uniform.

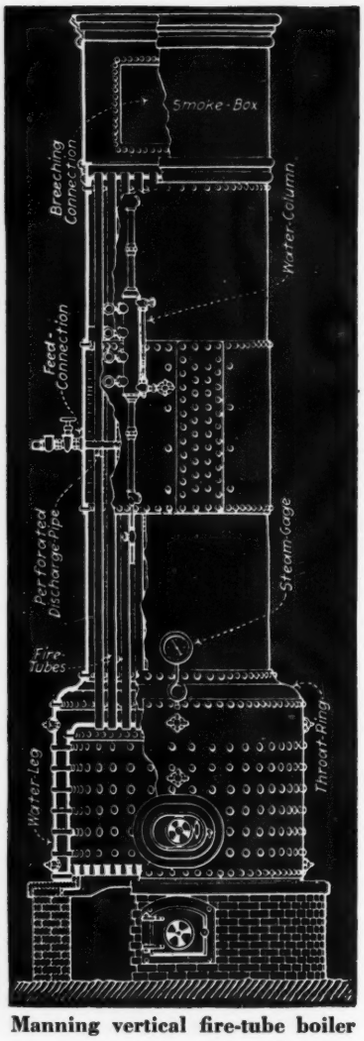
It would be advisable to consult the local boiler inspector; his advice will probably be to boil out with caustic solution and then re-roll tube ends. Once boilers are really free of oil, welding, as described, will take care of any further leakage.

Canton, Mass. H M SPRING

No Overheating With Clean Tubes

GRANTING TUBE SHEET was in good condition, tube holes clean and proper size, tubes polished where expanded, and a good mechanical job done in rolling to the proper size, there is only one thing that could cause leakage. That is a temperature in the area high enough to distort metal of the joint either in crown sheet or in tube, breaking intimate contact made by rolling process.

In my opinion, presence of oil in boiler caused leakage and foaming incidental to it. Oil prevented water from forming normal contact with metal. Before complete removal of oil by soda ash, this metal was far above temperature of other



Manning vertical fire-tube boiler

parts of boiler, causing distortion or movement. If boilers had been thoroughly cleaned of oil by cooking out with a very slow fire, using enough soda to emulsify all the oil, then cooled, drained, washed, and refilled with clean water, there could be no leaks. Clean metal surfaces in boilers conduct heat so rapidly that their temperature rises but slightly above that of steam or water.

Sheboygan, Wis. V E TODD

Blames Oil on Tube Seats

PRIMING AND FOAMING didn't cause leakage of tubes at crown sheet of MCC's boiler, though they probably helped. Foaming causes rapid expansion and contraction of tubes over small areas, tending to move the tubes in the sheets. I believe the trouble results (as did the foaming) from improper installation procedure. Before a boiler tube is put in, both tube and hole should be cleaned of all dirt, rust, and oil. If this isn't done, no amount of rolling will make tubes permanently tight; oil on tube seats will keep on giving trouble. Leaks can probably be eliminated by several rerollings after boiler is in service for some time and oil has had a chance to work out.

Saltville, Va. J C PORTER

Thinks Scale Causes Leaks

I WOULD SAY MCC'S TROUBLE comes from accumulated scale. Oil and impurities in feedwater form a heavy sludge or deposit which eventually falls to bottom of boiler, forming scale due to intense heat at this point. Scale probably causes leaky tubes as it forms around bottom of tubes, reducing surface at this point. Treatment won't dissolve scale as easily as sludge and it's a lot harder to remove scale from bottom of vertical boiler as tubes form greater resistance at time of blowdown. Further, circulation in vertical boilers is often sluggish, which also helps scale formation.

Philadelphia, Pa. W T MULLEN

—R A Wurgel Photo

Steam Line Covered With Newspapers

RELOCATING STEAM MAIN through city streets, one of the large Eastern utilities is building a terracotta trench wall. The trick shown here is to stuff the hollow tile full of crumpled old newspapers. Tile ends are sealed with cement. The newspapers reduce heat loss which would otherwise occur by circulation of air in the tile open spaces.—FIELD EDITOR.

ARGUMENT CORNER

No Controversy

BEING A PRACTICAL MAN and one who seeks to advance himself, I see no reason why there should be any controversy between the college man and the shop-taught man. Theory is a great thing, but practical operation is just as important.

It wasn't the college men who started this business, but a lot of fellows who were blacksmiths and mechanics. Their ideas were then taken in hand and developed further by those corresponding to today's college-trained men.

Even now, there are many who don't talk in fancy phrases who know what to do when something needs doing. So I say an engineer is any fellow who can design, construct, or operate power equipment properly.

Camden, N. J. G E W HILLARY

Are We Engineers?

GEORGE EDWARD'S "BABY" the Operating Engineer, is a fine addition to POWER. In June "Argument Corner", L Mackey has a lot to say about engineers. May I join the argument? I am chief engineer of the highest-pressure boiler and condensing top turbine in the State of Kansas.

Mr Mackey apparently believes the practical engineers are a dumb lot, so let's look at his "demonstrations"—first, the case of the man who said his generator "capacity" was 800 amperes.

The capacity of a generator is limited by its ability to withstand and dissipate heat. Since the heat is due almost entirely to the amperage squared, multiplied by resistance, it is obvious that a statement of generator capacity in amperes is quite a practical one. It's not so long since the electrical manufacturers changed alternating-current generator and transformer ratings to kva rather than kw for this very reason.

Now, to the water tender who closes the trap lines on boiler-feed pumps before starting them. Not knowing the set-up, I can't be sure of his reason, but it may be good. If an inverted trap is used, it must be sealed with water to operate. Now, if the trap is in operation, and the pressure is suddenly reduced a few pounds in the connecting steam line, the water in the trap will re-boil into the steam line, and unseal the trap, causing it to blow through. I've had this happen and corrected it with a swing check in line to trap.

If this analysis is correct, the water tender did the logical thing, although a swing check would be better. He may have some very good reason for closing the exhaust drains. I do not see them, but certainly 33 years' experience are not to be disregarded.

As for the engineer who carried 60% load on a turbine with no blades. I suspect he is one of those men who talks because he likes his own voice, and there are plenty of them, both educated and uneducated.

The one L M wanted figured out about the fireman who had more boiler-feed flow than steam flow, is probably explained as follows:

Some plants generating high-pressure, highly superheated steam must reduce and desuperheat part for low-pressure machines and processes.

Generally the steam flowmeter is on the boiler side of the desuperheating station and the boiler-feed meter shortly after the boiler-feed pump. Now, since the boiler feedwater is used for desuperheating as well as for boiler feeding, the feed meter will register more than the steam flowmeter by the amount used for desuperheating. I think this is the answer to the case in point, showing this man to be quite correct.

Now, for a couple of illustrations to show that not all the boneheads lack a college degree:

Some time ago, I visited a large central station in the middle west, and one of the most efficient in the U. S.

I noticed the turbine log has a column for vacuum readings, but none for barometer, nor absolute pressure. Certainly a vacuum reading without a barometer reading isn't worth much. This appears to be a slip by the technical staff or management. If a purely practical engineer did this he would be condemned for his ignorance.

I once was called to an electric plant superintended by a man with a BS in engineering. During the night they had dressed the commutator of an exciter. While down it had lost its residual magnetism, and would not generate when started. This man had put in three hours trying to restore the residual with a 6-volt storage battery on a 125-volt field.

I could give many illustrations of mistakes, or warped viewpoints, by technical engineers and practical engineers, but on none of them can I condemn the engineering fraternity as not being engineers, either technical or practical.

There is an inherent quality that is required to produce an engineer, and if a man does not have this quality all the education he can get will not make him an engineer in anything but name. Let us not be too critical of the man who may have this quality, but is unfortunate in not having the money to obtain a college degree.

Chanute, Kansas H R WILLIAMS

Are We Engineers? (Williams)

Rules for Area

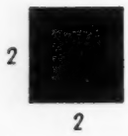
by Phil Swain

HERE ARE THE RULES for figuring the areas of every-day flat shapes

RECTANGLE

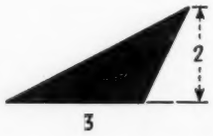
Rule: Area = one side × the other
Ex: Area = 2 in. × 4 in. = 8 sq in.

SQUARE



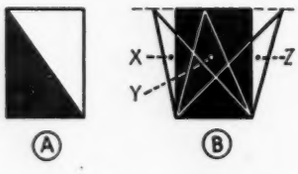
Rule: Area = side × side
Ex: Area = 2 in. × 2 in. = 4 sq in.

TRIANGLE



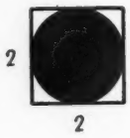
Rule: Area = ½ × base × altitude
Note: Take any side as base. Measure altitude at right angles to selected base
Ex: Area = ½ × 3 in. × 2 in. = 3 sq in.

MORE TRIANGLES



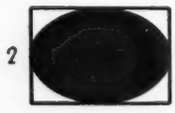
Rule: All triangles with same base and altitude have same area.
Application: Triangle below diagonal of rectangle in *A* is seen to have half area of rectangle. Triangles *X*, *Y*, *Z*, all have this same base and altitude. Therefore, area of *X* = area of *Y* = area of *Z* = area of triangle in *A* = ½ area of the rectangle.

CIRCLE



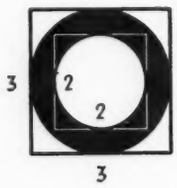
Rule: Area = 78.54% of area of square circle fits into.
Note: For most practical work you can drop the .04, and often the .5 also. Too much accuracy for the job in hand is waste effort.
Ex: Area of square = 2 in. × 2 in. =4 sq in. Area of circle = 0.7854 × 4 sq in. = 3.1416 sq in.

ELLIPSE



Rule: Area = 78.54% of area of rectangle ellipse fits into
Ex: Area of rectangle = 2 in. × 3 in. = 6 sq in.
Area of ellipse (approx.) = 6 × 0.78 = 4.68 sq in.
Area of ellipse (more closely) = 6 × 0.7854 = 4.7124 sq in.

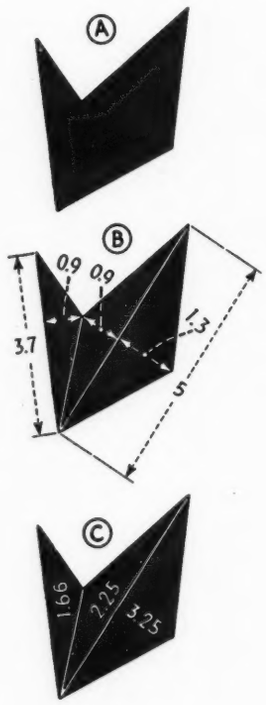
FLAT RING



Rule: Area = 78.54% of area of square ring
Note: Area of square ring = area of big square less area of small square
Ex: Area of big square = 3 in. × 3 in. = 9 sq in.

The area of the small square = 2 in. × 2 in. = 4 sq in.
Area of square ring = 9 — 4 = 5 sq in.
Area of round ring = 5 × 0.7854 = 3.927 sq in.

IRREGULAR POLYGON



Rule: Cut figure up into triangles. Figure area of each triangle from its measured base and height. Add these areas.
Note: Method applies to any shape whose sides are straight lines
Ex: Shape *A* is cut into measured triangles, as in *B*.
Left to right, areas of triangles (shown in *C*) are:
½ × 3.7 × 0.9 = 1.66 sq in.
½ × 5 × 0.9 = 2.25 sq in.
½ × 5 × 1.3 = 3.25 sq in.

Total area = 7.16 sq in.

(Future pages will show how to figure irregular flat areas and surface areas and volumes of solids.—PHIL SWAIN)

Locomotive-Type Boilers

by Harry Spring

Q—Name the sheets of a locomotive boiler.

A—Barrel or shell, smoke-box tube sheet, dome shell, dome head, wrapper sheet, throat sheet, firebox outside front sheet, firebox side sheets, firebox tube sheet, and crown sheet.

Q—Where is the fusible plug?

A—In the highest part of the crown sheet, projecting through at least 1 in.

Q—Where is the standard stamping?

A—On the firebox outside front sheet, usually over the firing door.

Q—Where is the most dangerous part of the boiler in case of low water?

A—The crown sheet.

Q—From which end are tubes removed and replaced?

A—The smoke-box end.

Q—How are firebox sheets supported?

A—Side, front and tube sheets are supported by staybolts. Crown sheet is supported by radial or girder stays.

Q—How may expansion of long firebox side sheets be accommodated?

A—Vertical corrugations in the sheets are used between several vertical rows of staybolts.

Q—What is required with sling stays not needed with radial stays?

A—Crown bars and girder stays.

Q—What are advantages and disadvantages of radial stays and girder stays?

A—Radial stays are more flexible and tend to hold less scale from circulation than girders. About the only advantage for girder stays is that they pass straight through the sheet rather than at an angle.

Q—If the segment of the smoke-box tube sheet below the tubes requires bracing, what type of stays may be used?

A—Any type of diagonal stay.

Q—Where is the usual location for the manhole?

A—In the dome head.

Q—How many manholes are there in a locomotive boiler? Why?

A—One. The part of the barrel over the tubes is the only accessible part of the interior.

Q—What should be the lowest level for the bottom nut of the gage glass?

A—The lowest visible part of the glass should be at least 3 in. above highest part of the crown sheet.

Q—How far through the sheets should staybolt ends extend before they are riveted over?

A—Not less than 2 threads.

Q—If you were to install part flexible staybolts and part solid, how would you arrange them? Why?

A—Install flexible staybolts in the top two rows, all the way around. The greatest furnace expansion and resultant staybolt breakage occurs at this point.

Q—May staybolts be welded in?

A—Most Codes allow this, but limit the stress to 6000 lb per sq in. in calculating maximum safe pressure based on strength of the staybolts.

Q—Why shouldn't feedwater discharge into the waterleg?

A—Cooling action of the water against the hot furnace sheets would cause serious stresses and probable damage.

Q—What are smoke box doors used for?

A—Inspection, cleaning, and tube replacement.

Q—What's the advantage of the thermo-syphon arch?

A—It increases boiler capacity by eliminating dead gas pockets in the upper and lower corners of the firebox, and by eliminating sluggish water circulation in the throat.

Q—What type of boiler is this in regard to firing and why?

A—Internally fired, as the furnace is within the boiler proper.

HOW TO SEIZE WIRE ROPE

SEIZING-WIRE SIZE

Wire-Rope Diam., In.	*Binding-Wire No. W & M Gage*
$\frac{1}{2}$ and less	18
$\frac{5}{8}$	17
$\frac{3}{4}$	16
$\frac{7}{8}$ to $1\frac{1}{8}$	14
$1\frac{1}{4}$ to $1\frac{7}{8}$	12
2 and larger	10

1

Before cutting non-preformed wire rope, seize (bind or serve) it on both sides of the proposed cut with soft annealed low-carbon-steel wire. Cut seizing wire in suitable lengths, depending on size of rope. Hold one end with fingers of left hand against rope and, with right hand, wind wire tightly around rope

2

Wind 4 or 5 turns of seizing wire around rope, keeping turns close together. With fingers, twist ends of wire together sufficiently to hold seizing in place

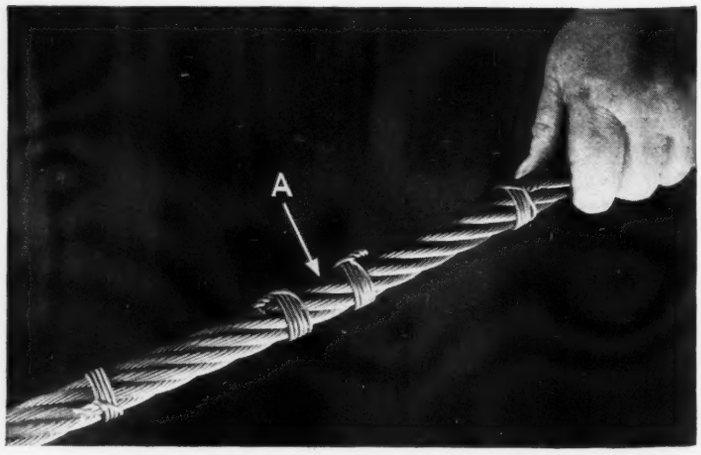
3

Grip twisted ends in pliers, place jaw against rope and pull seizing as tight as possible without overstressing the wire. Seizing must hold the rope securely against any movement of the strands when cut

4

Twist ends of wire with pliers to take up all slack gained in step 3. Cut off twisted ends, leaving about 4 twists to hold seizing, and flatten twist onto rope

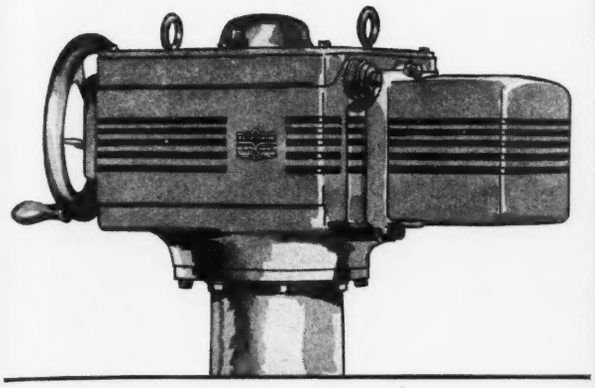
Photos courtesy of A Leschen & Sons Rope Co



5

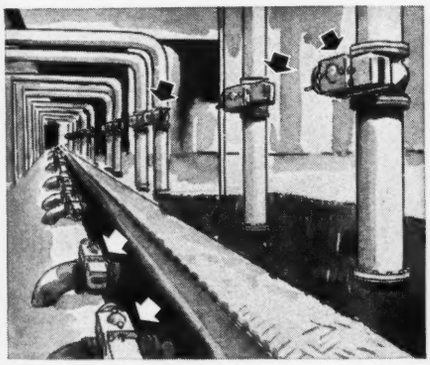
After seizing, cut is made at *A*. For iron and small steel rope, seize it at least 2 times; 1-in. to 1.5-in steel rope seize 3 times; and larger steel rope seize at least 4 times each side of cut

ELECTRIC VALVE CONTROL SAVES LIVES, TIME AND MONEY

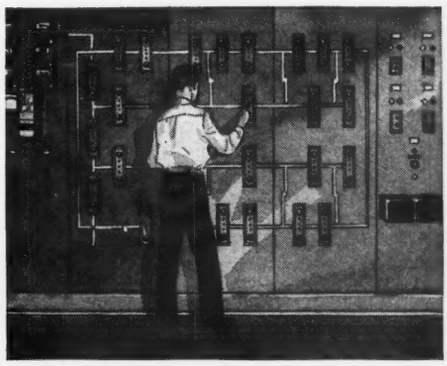


PUSH A BUTTON to open or close valves equipped with Cutler-Hammer Electric Valve Control. No running back and forth, climbing ladders, shouting of orders. Control station located wherever most convenient, or control may be automatic.

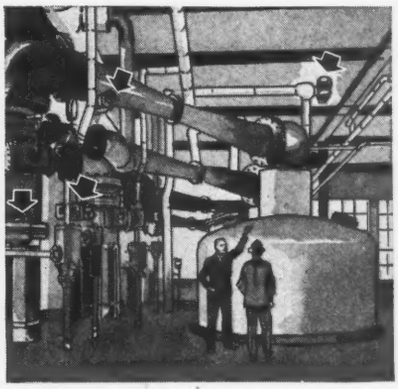
BACK SAVER. Closing large valves manually, is hard, time-wasting work. Valves only ⅓ the size shown here, when opened or closed by hand, require 15 minutes' hard work by 2 men for either operation. C-H Valve Control, 90 seconds at the touch of a button.



LIFE SAVER. Ability to close valves from remote point is great safety aid in handling high pressure steam, gasoline or inflammable gases where break in line might prevent men reaching valves.



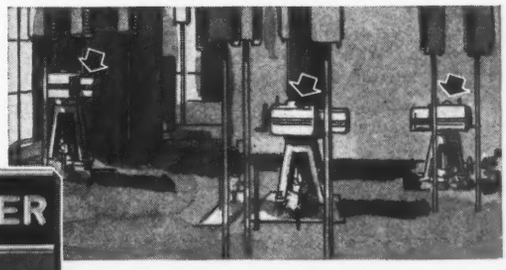
TIME SAVER. Valves may be located miles from control station, as is frequently done in city water or gas systems with C-H Control. Entire city supply controllable by districts at one central location. Invaluable in case of emergency.



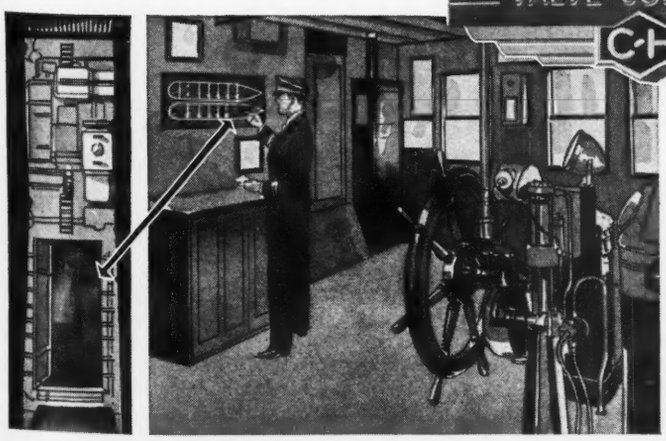
MONEY SAVER. Chemical and food products plants use C-H Valve Control, often for automatic operation by connection with timing devices, float or pressure switches, etc. C-H Valve Control can handle *anything* that flows.

Experts insist on—

CUTLER-HAMMER
VALVE CONTROL
C-H

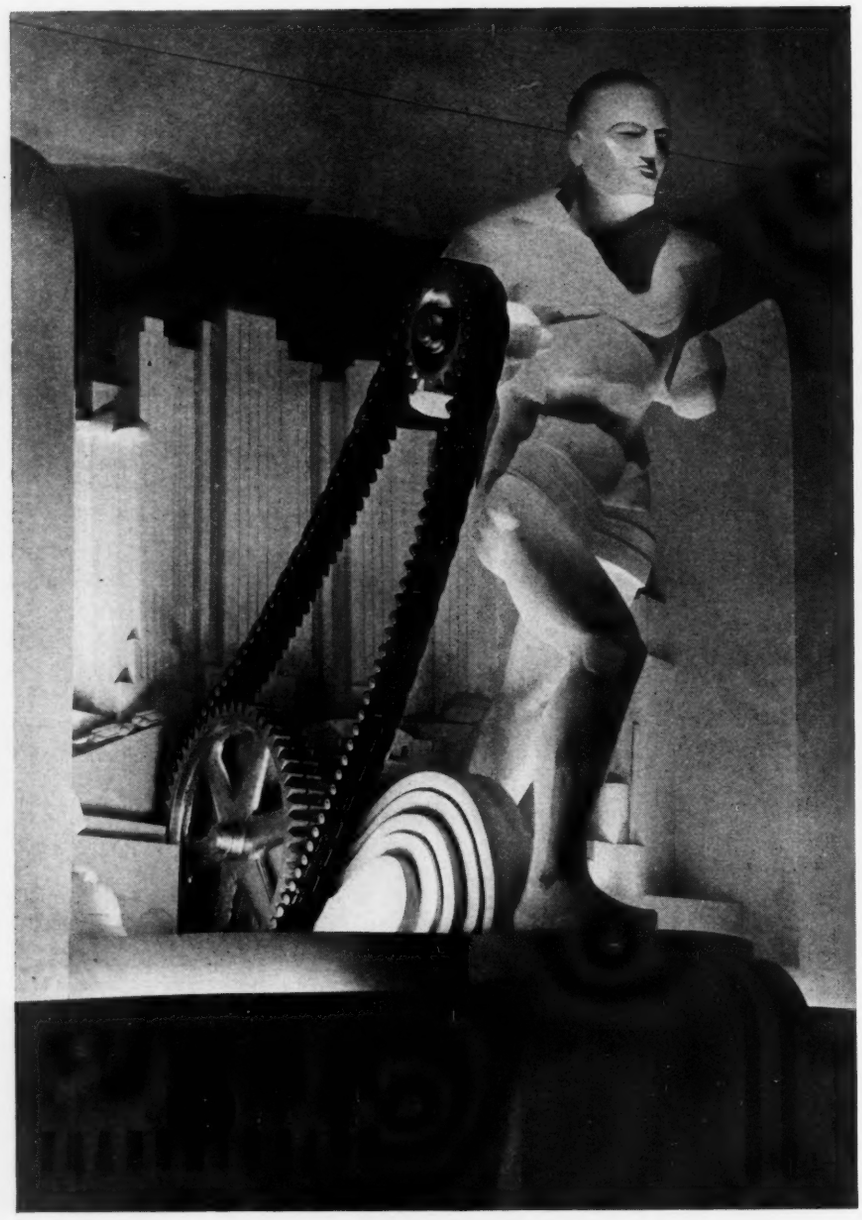


RED HOT JOB. Modern power plants operate with superheated steam at 900° F and pressures as high as 2000 lbs. Pipes and valve parts actually glow at red heat. Jamming red hot valve parts is avoided by C-H Valve Control.



ONLY A FEW of the many uses for C-H Valve Control are here described. As shown at the left, it is used for closing bulkhead doors from the captain's bridge—to guard lives at sea in case of collisions. You may find C-H Valve Control the answer to *your* problem. Write for information. CUTLER-HAMMER, Inc., *Pioneer Electrical Manufacturers,* 1209 St. Paul Avenue, Milwaukee, Wisconsin.

Power Lines



"SPIRIT OF POWER TRANSMISSION"

Part of the Link-Belt exhibit in the Metals Building at the N.Y. World's Fair is this sculptured figure, executed by Walter A Sinz, of Cleveland

Herbert Hoover to Address Semi-Annual ASME Meeting

Herbert Hoover, former president of the United States, and honorary member of the ASME, will address the semi-annual meeting of that group to be held in San Francisco, July 10-15. Thursday, July 13, has been designated as Engineering Day at the San Francisco World's Fair, and engineers will visit plants, factories, and other informative places in addition to the regular sight-seeing at the Fair.

Fourteen technical sessions, sponsored by the Aeronautic, Fuels, Hydraulic, Heat Transfer, Power, Management, Process Industries, Oil and Gas Power, and Materials Handling Divisions of the ASME will feature 28 papers by outstanding engineers.

Some of the papers are: "Some Problems in the Burning of Fuel Oil," by A W Anderson; "Design and Operation of DeFlorez Furnaces," by George C Leslie; "Problems Encountered in the Design and Operation of Impulse Turbines," by R M Peabody.

"The Performance Characteristics of a Mechanically-Induced-Draft, Contraflow, Packed, Cooling Tower," by A L London, W E Mason, and L M K Boelter; "Fundamental Relationships in the Design of Cooling Towers," by G Russell Nance; "The Characteristics of Atmospheric-Type Burners When Used with Natural Gas," by Everett D Howe and Harold G Johnson.

"The Economic Thickness of Insulation for Pipes in Intermittent Service," by R L Perry and W P Berggren; "Boiler Performance with Natural Gas Firing," by F G Philo; "Elements Entering into the Exact Measurement of Natural Gas," by John Overbeck and S R Beitler; "An Improved System in the Application of Noncondensing or Extraction Turbines," by H W Cross and E S Wells, Jr, and "Gas-Turbine Problems," by Adolph Meyer.

Dow Employees Attend Combustion Night School

Power Department employees of the Dow Chemical Co, Midland, Mich., studied the principles of combustion last winter in a school, divided into two classes, meeting one night each week. The school was sponsored by the local NAPE and instructed by L L Moran, asst chief operating engr. The classes met for 14 weeks during the winter months, in the Dow Chemical Co's new auditorium. Course was free, except for textbooks, cost of which was met by the students. Total enrollment was 96.

ASRE Meets at Hershey

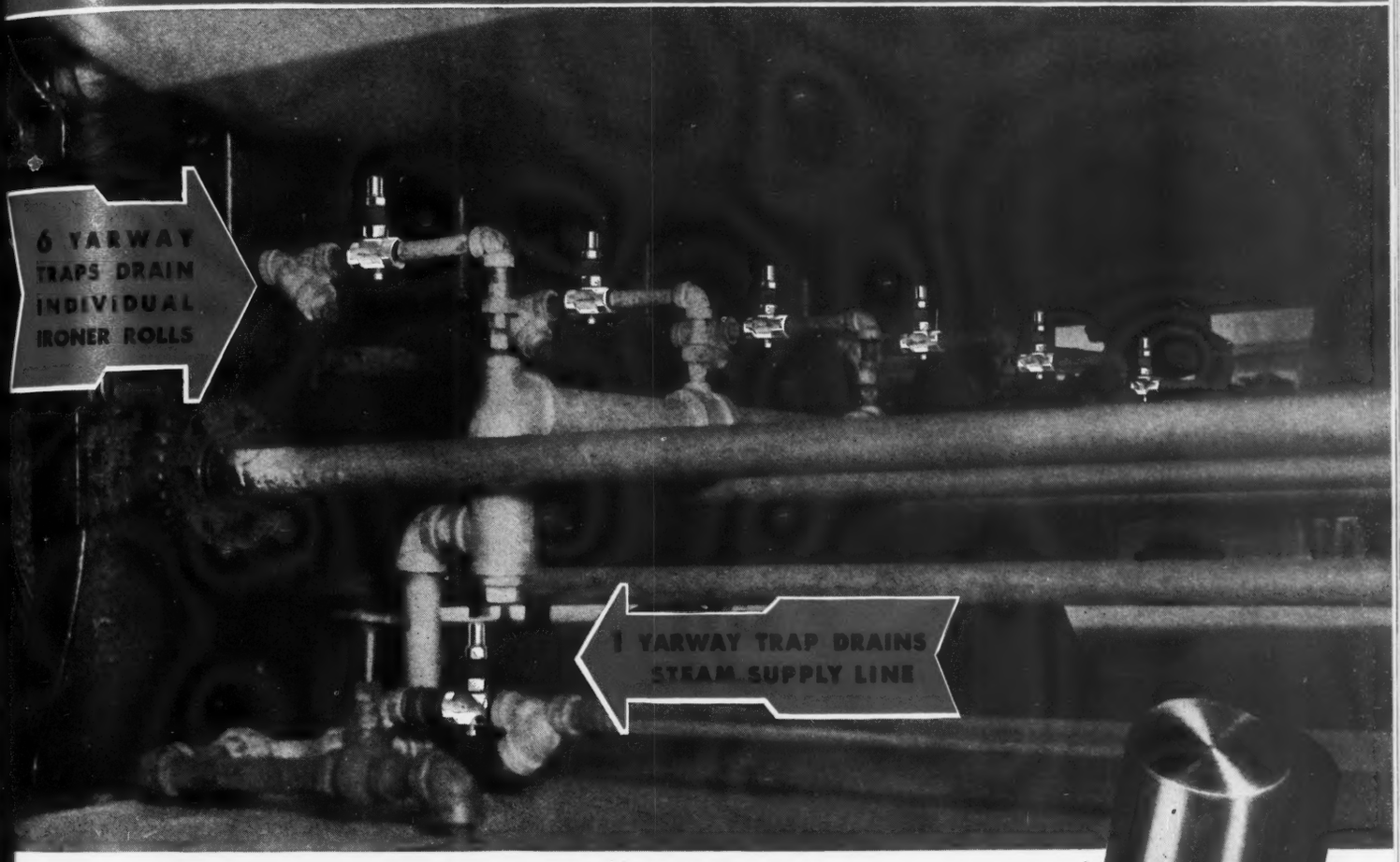
Members of the American Society of Refrigerating Engineers journeyed to Hershey, Pa., to attend the 26th Spring Meeting, May 22–23, to hear a varied group of papers, and to have a grand time sampling Hershey's sport and recreation attractions.

Highlight for many was an inspection trip through buildings of the Hershey Corporation, including the windowless offices, and a talk by V C Patterson, York Ice Machine Corp, who told of the history and present use of refrigeration in manufacture of cocoa powder and chocolate products. Refrigeration capacity in the Hershey plant grew from 70 tons in 1903 to a present total of 2090 tons, 1665 tons from ammonia and 425 tons from Freon-12.

List of applications of refrigeration shows how it enters many phases of process: chocolate tempering and molding, cocoa-powder processing, milk, drinking-water and storage-room cooling, and air conditioning in windowless office building, wrapping and packaging rooms, and printing department. Mr Patterson wound up his talk by describing the cooling system for processing cocoa powder and showing gains in floor space, defrosting requirements, and operating ease made by replacing an old bunker system by a new tunnel system.

Operating all kinds of air conditioning equipment in buildings of various ages and types provided the experiences reported by Charles A Peters, U. S. Department of Interior, in "Air Conditioning in Government

Ironer Several Degrees Hotter with YARWAY IMPULSE STEAM TRAPS



Seven of 18 Yarway Traps at Briarcliff Laundry, Atlanta. Notice individual trapping of rolls and steam line.

Owners are "very enthusiastic about Yarway Traps as we have found much better drying is obtained from this machine and other Yarway trapped equipment. On our mangles, for instance, top cylinder temperature has been increased 20 degrees."

Not only for quicker heating and greater sustained heating efficiency; but for many other distinct advantages—Yarway Traps are replacing less efficient, less dependable devices in many plants.

Have you investigated this trap about which user says,—"saves fuel,"—"saves space,"—"easier and cheaper to install,"—"we like its flexibility on different pressures,"—"saves maintenance trouble and expense,"—"cheaper to replace with Yarways than to repair old-type traps," etc., etc.

More than 50,000 Yarway Impulse Traps are already in service and orders this year are at an all-time high—as satisfied users call for more and more.

End your trap troubles. Ask for Bulletin T-1734 or see your local mill supply distributor.

YARNALL-WARING CO., 100 Mermaid Ave., Philadelphia

YARWAY IMPULSE STEAM TRAP

Buildings in Washington." After citing some operating troubles and indicating possible improvements in equipment, Mr Peters went on to emphasize the importance of air movement and control of temperature, humidity, and other factors. Most complaints can be traced to manner of introduction of air into rooms and this entire phase of installation practice must be carefully studied to eliminate drafts and other disturbances. Mr Peters concluded by presenting some costs which indicate that advantages of air conditioning were provided at an operating cost of less than 1% of total salaries of building occupants.

Of interest to industrial power engineers in the brewing field was a paper "Handling of Brewery Fermentation Gas" by Leon Buehler Jr, Frick Co, and Louis De Markus, Louis De Markus Co. Tracing first the part CO_2 plays in the brewing and bottling of good beer, the authors then discussed methods of handling and storing the gas to match production with demand, showing the advantages of a recently perfected system for liquefying CO_2 and storing it in this more economical way.

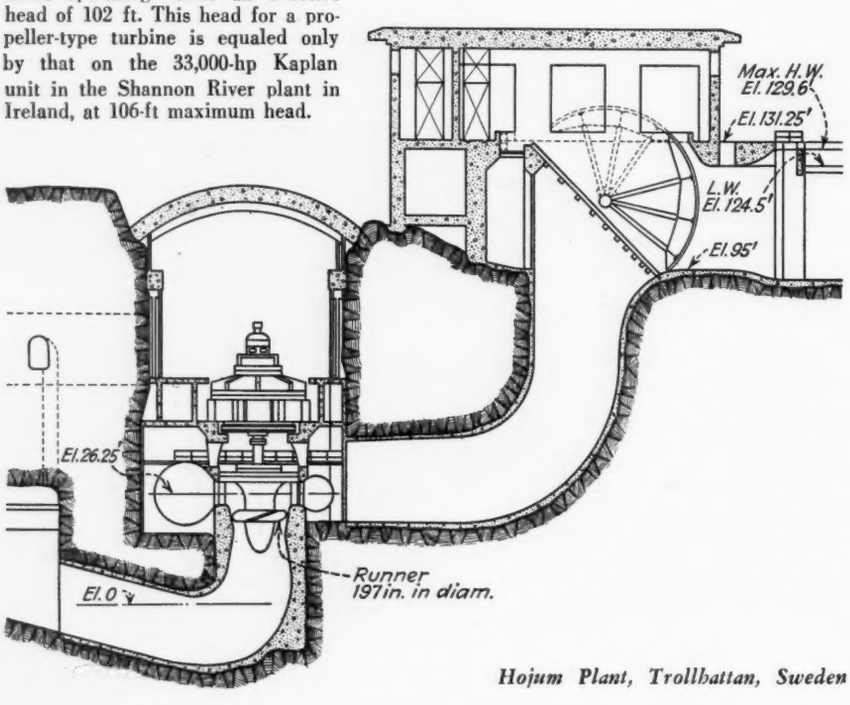
Other papers included: "A Portable Calorimeter for Small Compressors," by D D Wile; "Thermodynamic Properties of Methyl Chloride," by H G Tanner, A F Benning, and W F Mathewson; "Refrigerated Truck Bodies for Ice Cream Delivery," by H M Harrington and L M S Cooper; "Overhead Bunkers for Refrigerator Cars," by O C Walker; "Forced Air Circulation for Refrigerator Cars," by Dr F C Lindvall; and "Bus Air Conditioning," by A J Mallinckrodt and Lars Hanson.

Kaplan Hydro Turbines Make New Record

A new hydroelectric-unit record will be made in the Hojum plant now under construction at Trollhattan, Sweden. This plant when completed will have an installed capacity of 186,000 hp in 3 Kaplan-type turbines operating under an effective head of 102 ft. This head for a propeller-type turbine is equaled only by that on the 33,000-hp Kaplan unit in the Shannon River plant in Ireland, at 106-ft maximum head.

Even though the head on the Shannon River unit approximates that on the Hojum turbines, the capacity of the latter is practically double that of the former. In fact, only the Bonneville Kaplan turbine has a greater capacity than those to be installed in Hojum plant. At Bonneville the two turbines installed are rated 66,000 hp and the two on order, 74,000 hp, 75-rpm under a 66-ft head, all runners being 280 in. in diameter. At Hojum, the turbines are rated 62,000 hp under a net head of 102 ft. Speed will be 136.3 rpm with runner diameter 197 in.

Of bomb-proof construction, the turbine and generator room is built in an excavation blasted 90 ft deep in solid rock, as in the figure. Roofs over the machine room and intake works will also be of bomb-proof construction. Two units comprise the initial installation. One will be built by Nydquist & Holm, Trollhattan, and the other by Verkstader, Kristinehamm, Sweden. Initial operation is planned for late 1942.



Hojum Plant, Trollhattan, Sweden

Public Utilities Face the World of Tomorrow

"There will be no power shortage," said president C W Kellogg, at the 7th Annual Convention of the Edison Electric Institute, held at the Waldorf-Astoria Hotel, New York, N.Y., June 5–9.

EEI president Kellogg presented a complete report of the status of the electric industry during the past year, in which he stated that fears of a power shortage were groundless. Consider, he said, that the utilities have been spending 3% annually of their gross revenues trying to create a power shortage, without achieving too great a degree of success. He added that the use-hours of a kilowatt of capacity had increased from 2800 hours per year to 3300 hours and that, in event of war-time industrial schedules, procurement plans contemplated increasing this figure to 4200. The problem would be, he said, for the utilities to sell present idle hours of existing capacity rather than to install additional generators.

Mr Roy Wenzlick, real estate analyst, painted an optimistic picture of the future of residential and commercial building in the near future with obvious beneficial effect on utility loads. Reasoning from a chart of real-estate booms and depressions dating back as far as 1830, he pointed out that we have every reason to expect another year or two of fluctuating prices immediately followed by a sharp increase in building activity.

The outlook for the electric utilities was the subject of a talk by Floyd L Carlisle, Consolidated Edison Co of New York, who pointed out that the public utilities can use large amounts of capital every year, an important factor in the country's finding its way out of deficit financing. Lenox R Lohr of the National Broadcasting Co described the technical and economic problems to be solved before commercial television becomes a self-supporting proposition.

U. S. Contracts for Shasta Dam Turbines

Contracts totalling $1,911,255 for four 103,000-hp turbines with governors, and two 3500-hp turbines and governors were awarded in May to the Allis-Chalmers Mfg Co, Milwaukee, Wis., and the James Leffel & Co, Springfield, Ohio, respectively. The power machinery is to be installed in the power plant of the Shasta Dam of the Central Valley reclamation project in California.

The large turbines are for Units 1, 2, 3, and 4, of the Main Shasta Dam power plant, and are vertical-shaft, single-runner, Francis-type, with spiral casings. They are designed to operate at a normal speed of 138.5 rpm, and to be operated under a head of water which may vary from a minimum of 238 ft. to a maximum of 475 ft, striking an average of about 408 ft.

The smaller turbines and governors are to be used for station service, to operate machinery and other equipment at the dam.

The power plant of the dam will be on the right bank of the Sacramento River, looking downstream, at the toe of the dam, 9 miles north of Redding, Calif. The dam will be 560 ft high, and will have a crest length of 3500 ft, one of the largest and most massive dams built, second only to Boulder and Grand Coulee Dams.

Penn State Association Host To Power Engineers

Pennsylvania State Association, National Assn of Power Engineers, held its annual convention and power conference in Philadelphia, June 16, 17, and 18. The sessions included many papers presented by engineers, a special ladies program, stag parties, historical trips, and the annual State Assn picnic.

Among the papers presented were: "Lubrication", Benjamin F Hunter, chief

Find out the why of

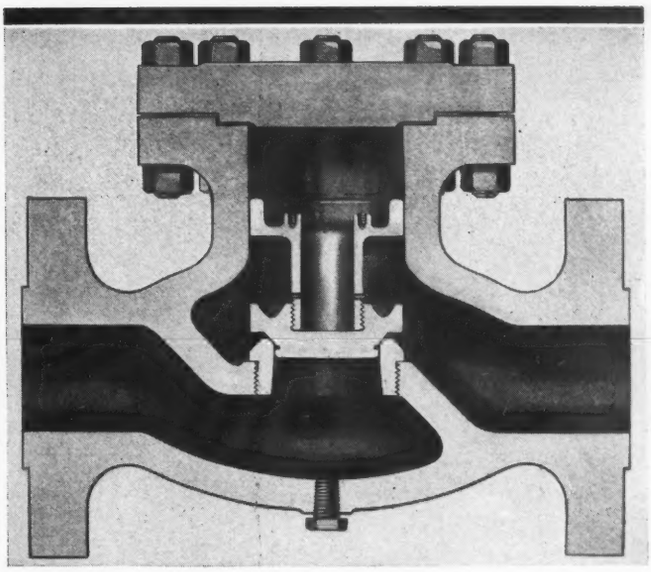
EDWARD PISTON CHECK VALVES

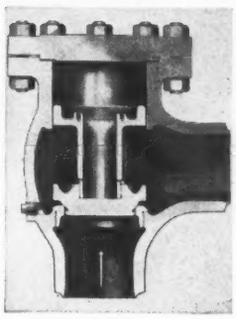
Edward piston check valves do their important jobs quietly and efficiently. Their cushioning action provides the simplest and most effective means of avoiding shock, slam and clatter. It was the happy analysis of a tough problem that led Edward years ago to pick the lift check—with emphasis on the piston—for high pressure service.

NEW DESIGNS STILL BETTER. Numerous changes in design detail have been completed during recent months, to the lasting betterment of the product. These valves should do a better job of taming vicious fluctuations, without excessive loss of head, than any other type. Accurately guided, but with sufficient clearance to avoid jamming or sticking, these valves respond immediately to reversal of flow. Gravity drives the sturdy disk-piston assembly to its seat, just slow enough to avoid jar.

MATERIALS ALWAYS COUNT. Selection of materials for check valves, always an important question, has been given renewed attention. All parts are made under the watchful eyes of laboratory and shop inspectors. Most parts are identical with those used in the Edward non-return valves, with which Edward's reputation is definitely associated. If you have a particularly puzzling return flow problem, you might let us know the details. In some cases the addition of EValloy piston rings to standard Edward check valves has proved helpful.

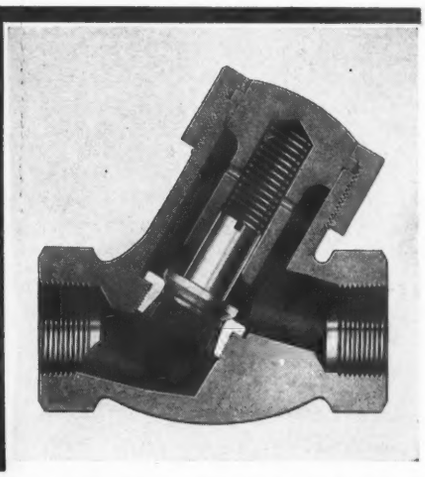
THE EDWARD VALVE & MFG. CO., INC
EAST CHICAGO INDIANA

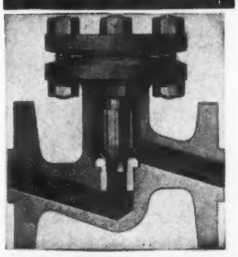




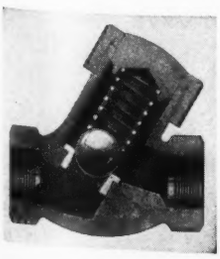
THEY CAN'T SLAM. These two cuts (flanged ends above, welding ends right) show typical construction in sizes 2½" and up. Full provision has been made to provide positive action, freedom from chatter or jar, and no undue restriction of flow. Edward details have been worked out so as to cushion action, provide tight closure, and avoid wear by erosion or abrasion. Three types—horizontal, vertical and angle.

PRECISION GUIDES. In cast valves — steel and Ferac metal (iron) guidance is given by three relatively narrow ribs which keep the disk always centered, but give no lodgment for foreign matter. The disk can go nowhere but home. Bearing surfaces are adequate to prevent wear of moving parts.





FORGED STEEL VALVES. Small valves (left and above) follow same basic principles with certain modifications due to needs of space. Screwed end valves of the "Y" design are particularly useful as they may be installed in horizontal or vertical lines—with the disk travel in a downward direction.



FOR SOME USES, BALL CHECKS. For viscous fluids the piston design may be out. Ball checks usually provide a desirable substitute when the fluid serves to damp the jar of reverse flow. Shown is Edward Fig. 2672, which is particularly popular in oil refineries and process plants.

EDWARD VALVES

Representatives of the Tufts College, Medford, Mass., recently presented John T Solbjor, chief engineer of the Huntington Ave buildings of the institution for 30 years, with a pen set and autographed book in appreciation of his services. Left to right: Dean A Warren Stearns, Medical School; Mr Solbjor; C S Cassidy, Bursar; Dr William A Hoyt, Medical Faculty; and Dean Howard M Marjerison, Dental School

lubrication engr, Gulf Oil Corp; "Embrittlement", W C Schroeder, senior chemical engr, U. S. Bureau of Mines; "Belting," Edgar Rhoades, president, J E Rhoades & Sons; "Boiler Welding," John F Randall, welding engr, Combustion Engrg Co, Inc; "The Power Engineer and the Electric Co", J Frank Gaskill, sales manager, Philadelphia Electric Co; and "The Diesel Engine and Its Application in Power Plants," S E Mengel, engr, Superior Engine Div, National Supply Co.

British Engineers to Meet With ASME in New York

With the New York World's Fair to provide an interesting background for discussions and trips, the Institution of Mechanical Engineers of Great Britain will journey to the United States and hold a joint meeting with the ASME, Sept 4 to 8. At the same time, the Civil Engineers and the Engineering Institute of Canada are meeting with the American Society of Civil Engineers, and will in turn join the two mechanical engineering groups. The program includes sightseeing trips around New York, the Fair, and other spots of interest. The technical program will be coordinated with visits to the corresponding industries at the World's Fair.

Following the joint New York meeting, the British groups will visit Canada; Detroit, Mich.; Washington, D. C.; Philadelphia, Pa.; and Cincinnati, Ohio.

Total Water-Power Capacity 18,093,706 Hp

Total installed capacity of water-power plants of 100 hp or more in the U. S. and outlying territories on January 1, 1939, was 18,093,726 hp, according to a report from the Federal Power Commission. This figure represents an increase of 648,209 hp over Jan 1, 1938.

The report also shows that of the U. S. total for water-power plants of 100-hp or over, 15,826,678 hp were installed in electric utility plants, while 2,122,228 hp were installed in industrial and miscellaneous plants. As of Jan 1, 1939, electric utilities operated 1602 of the 2669 water power plants in the U. S., while the remainder, 1267, were operated by industrial or miscellaneous companies.

Semi-Annual ASHVE Meeting July 4-6

Several papers of interest to power men will be presented at the 1939 Semi-Annual Meeting of the American Society of Heating and Ventilating Engineers, to be held July 4–6 at Mackinac Island, Mich.

Outstanding in this respect will be "Fire Protection for Air Conditioning Systems," by R C Loughead, "Performance of Cooling Towers," by B M Woods and L M K Boelter, and 'Ozone in Ventilation," by W N Witheridge and C P Yaglou.

Other speakers will discuss fundamental matters of interest to designers: "A Theory Covering the Transfer of Vapor through Materials," by F B Rowley; "Effect of Size and Type of Air Inlet and Outlet on the Heat Output of Convectors," by A P Kratz, M K Fahnestock, and E L Broderick; "Summer Cooling Requirements in Different Metropolitant Districts with Special Reference to Washington," by F C Houghton, F E Spurney, and Carl Gutberlet; and "The Effect of Vibration on Free Convection, " by R C Martinelli and L M K Boelter.

TWIN BRANCH STATUS

Construction work at the Twin Branch plant of the Indiana & Michigan Electric Co is proceeding according to schedule. The sub-mat for the 22,500-kw, 2300-lb turbine has been poured. Practically all major equipment and material have been purchased.

Boiler Manufacturers Meet at Hershey, Pa.

After years of annual conventions at Skytop, Pa., the American Boiler Manufacturers Assn and Allied Industries held its 51st Annual Meeting, June 4–7, at Hershey, Pa. About 100 members, associate members and guests (including ladies) registered at Hotel Hershey. The program, as usual, was 50–50 business and pleasure—the latter mostly golf on the famous courses of the chocolate town. Many took time out to visit the great institutions founded on billions of chocolate bars—the factory, civic center, industrial school, rose garden, etc.

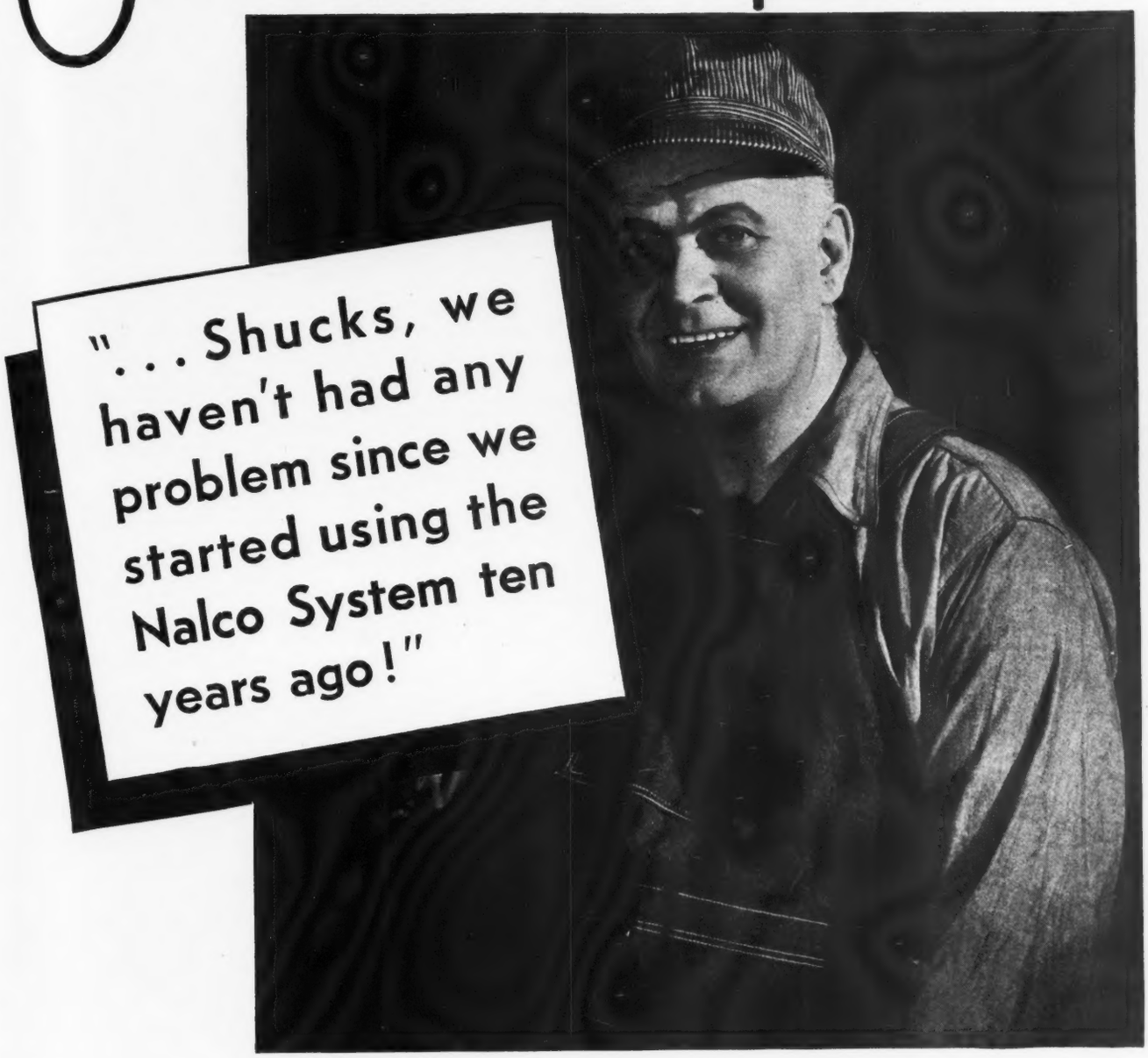
The E H Wells golf trophy, ABMA & AI championship trophy—36 holes low gross—was won by Hugh L McCulloch (B&W & Goldie-McCulloch). T T Watson (Lukens Steel) won the 36-holes low net championship for associate members and guests. R L Beers (Detroit Stoker) won the members handicap—18 holes low net. The 18-holes low net for associate members and guests was won by E N Keyes (National Tube).

At the annual dinner, F H Daniels (Riley Stoker) awarded the golf prizes and trophies. Speakers were E W Nick (Northern Equipment Co) and P W Swain (POWER). Reelected ABMA & AI officers are: president, Walter F Keenan, Jr (Foster Wheeler); vice-president, E T Knobloch (Union Iron Works); secretary and treasurer, A C Baker.

Large Group Attends Annual Stoker School

Nearly 600 men from several states and distant places registered for the 2-day first annual Northwest Coal and Stoker School held at the Dunwoody Institute, Minneapolis, Minn. The school was sponsored by the Twin City Stoker Assn, Northwestern All-Rail Coal Shippers, Northwestern Dock Operators, Twin City Fuel Exchange, Northwestern Coal Dealers Assn, and the Dunwoody Institute.

"Our Feedwater Treating Problem...?"



HUNDREDS of engineers, over 3500 in fact, are finding that it pays to let Nalco do the worrying about boiler water treatment in their plants. We think that you, too, will find that this pays.

If you are like most of us, you probably have plenty of other problems that you could more profitably spend your time on IF you had the right kind of service on feed-water. We believe we can give you that kind of service. Complete information on request. NATIONAL ALUMINATE CORPORATION, 6222 W. 66th Place, Chicago, Illinois.

THE NALCO SYSTEM OF FEEDWATER TREATMENT

Inquiries other than domestic, *except those from U. S. Possessions, Canada and Mexico,* should be addressed to ALFLOC LTD., Bush House, Aldwych, London, W. C. 2, Eng. Canadian inquiries should be sent to ALUMINATE CHEMICALS LTD., 372 Bay St., Toronto, Ont.

Meetings

American Society of Heating and Ventilating Engineers——*45th Annual Meeting, July 2–5, Grand Hotel, Mackinac Island, Mich. A V Hutchinson, secretary, 51 Madison Ave, New York, N. Y.*

American Society of Mechanical Engineers——*Semi-Annual Meeting, July 10–15, San Francisco, Calif. Also Fall Meeting, September 4–8, New York, N. Y. C E Davies, secretary, 29 W 39th St, New York, N. Y.*

ASME Fuels Div, and AIME Coal Div——*Joint meeting, October 5–7, Columbus, Ohio.*

Master Boiler Makers Association——*Annual Meeting, October 16, Sherman Hotel, Chicago, Ill. Exhibit in conjunction with meeting. A F Steglmeier, secretary, 29 Parkwood St, Albany, N. Y.*

National Association of Power Engineers——*Annual Meeting, August 28–Sept 1, Claypool and Lincoln Hotels, Indianapolis, Ind. Exhibit in conjunction with meeting. Fred Raven, secretary, 176 West Adams St, Chicago, Ill.*

Universal Craftsman Council of Engineers——*Annual Meeting, Aug 1–3, Providence, R. I. Exhibit with meeting. T H Jones, secretary, 4034 N 21st St, Arlington, Va.*

It was the first school of its kind, and the topics were purposely limited, so that more information could be presented. Two major subjects the committee set for this session were automatic coal stokers, and coal for stokers.

Some of the papers presented included: "The Progress of Domestic Stokers," Marc G Bluth, manager Chicago office, National Coal Assn; "Proper Installation of Stokers," Robert F Mulligan, chief engineer, Stoker Maintenance Corp; "Electrical Controls of the Stoker," John Paulding, vice-president, Minneapolis-Honeywell Regulator Co.

The school and sponsoring organizations presented the Dunwoody Institute with a modern domestic stoker, and a modern warm-air furnace, for use by the student body in studying automatic heat for air conditioning.

A G Christie Honored

A G Christie, Professor of Mechanical Engineering, Johns Hopkins University, was awarded an honorary degree by Stevens Institute of Technology, N. J., at the Commencement exercises held June 10. Prof Christie is president of the ASME, member of the American Gas Assn, and a member of the National Electric Light Assn. He is well known through all engineering circles, and heads the Engineering Dept at Johns Hopkins University in Baltimore, Md.

BUSINESS ITEMS

R W Cramer Co has moved factory and general offices from 67 Irving Place, New York, to Centerbrook, Conn. R W Cramer is president of the company.

Roots-Connersville Blower Corp, Connersville, Ind., has appointed the following turbine-pump territorial representatives: Southern Calif. Engrg Co, Los

(Continued on page 142)

NEW PLANT CONSTRUCTION

McGraw-Hill Business News Department Is Prepared to Furnish a More Complete Daily Service

Calif., Vernon—Bohemian Distributors, L. Chaffee, in charge, 2060 E. 49 St., taking bids constructing 1 story and part 2 story, rein.-con., steel winery and warehouse, 225 E. 49 St. $125,000. H. Eckart, 1015 E. 8 St., Los Angeles, archt. and engr.

★**Ga., Atlanta**—National Biscuit Co., 681 Whitehall St. S.W., plans constructing 1 story, 330x900 ft. bakery. Murphy and Arden Aves. S.W. $2,000,000. L. Wirching, 449 W. 14 St., New York, N. Y., archt.

Idaho, Sandpoint — Northern Idaho Rural Electrification Rehabilitation Assoc., plans constructing dam on Priest River near outlet of Priest Lake, amp. powerhouse, to production 1500 H.P. $200,000 REA funds sought. A. Sickler, Coeur D'Alene, engr.

Ill., Chicago—Arrow Co., c/o C. K. Levey, secy., 3033 W. Grand Ave., plans constructing eight 1 and 2 story factory buildings. North Ave. and First St., in Proviso Twp., Cook Co. $150,000.

Ill., Chicago — Chesapeake & Ohio R.R., Midland Bldg., Cleveland, O., plans rebuilding 4 grain elevators about 4,000,000 bu. capacity. near 103 St. and Calumet River. $1,000,000. Rosenbaum Bros., 141 W. Jackson Blvd., lessee.

Ill., Chicago—Commonwealth Edison Co., 72 W. Adams St., plans constructing power plant. Sargent & Lundy, Inc., 140 S. Dearborn St., engr.

Ill., Chicago—Norris Grain Co., 141 W. Jackson Blvd., plans rebuilding 2 grain elevators, near 102 St. and Calumet River, $1,000,000. Architect not appointed.

Ill., Springfield — City plans constructing power generating plant, at Lake Springfield, northeast of city. $500,000. S. J. Sibley, City Hall, supt. City Water, Light & Power.

Ill., Wood River—Shell Union Oil Co., Roxana (Hammond), Ind., tentative plans constructing refinery. $10,000,000 or more.

Ill., Woodstock—Alemite Die Casting Co., 222 S.N. Bank Dr., Chicago, plans constructing 1 story basement, factory. $200,000. Private plans.

Ill., South Pekin—Commonwealth Edison Co., 72 W. Adams St., plans constructing fourth generating unit, 105,000 kw capacity. at Powerton Station, also constructing new 220,000 volt transmission line to connect Powerton plant with company's Crawford station in Chicago, 147 mi.

Ind., Indianapolis—Allison Eng. Co., Speedway City, subsidiary General Motors Co., General Motors Bldg., Detroit, soon lets contract fdns. 1 story, 432x650 ft. brick, rein.-con. plant on 12 acre site. Bids later on superstructure. Total est. $6,000,000. Austin Co., Euclid Ave., Cleveland, O., archts. Lloyd Allen, 638 Architects & Builders Bldg., Indianapolis, superv. engr.

Ind., Rensselaer—Bids June 5, by Bd. P. Wks., J. Merritt, clk., remodeling light and power plant, engine foundation, electric wiring, steam piping, cooling tower, 3 sump pumps, 8 centrifugal pumps. Project consists of building new power house around old plant and later demolition old building. $70,000. J. W. Moore & Son, 834 Ind. Pythian Bldg. Indianapolis, consult. engrs.

Ia., Bancroft—Bids June 20, by City, constructing brick, tile power plant, 2 diesel generating units, complete distribution system, various auxiliary equipment. A. S. Harrington, Baum Bldg., Omaha, engr.

Ia., Clinton—The Clinton Co., Clinton, plans constructing powerhouse and installing steam and electrical generating power equipment. 3 steam generating units, $960,000. Maturity 1939.

Ia., Jefferson — City plans constructing municipal light plant. K. R. Brown, 903 Valley Bank Bldg., Des Moines, engr.

Ia., McGregor—Town plans constructing municipal electric plant and distribution sys. Young & Stanley, Inc., Muscatine, Ia., engr.

Ia., Montezuma—City plans constructing power plant and distribution system. $136,000. Bonds approved. A. S. Harrington, Baum, Bldg., Omaha, Neb., engr.

Ia., New Hampton—City, preliminary surveys, enlargement and improving municipal electric light plant. $183,120-$238,045. R. D. Thomas & Assoc., 1200 2nd Ave., Minneapolis, Minn., engrs.

Ia., Preston—Voters approved $45,000 bonds, electric light and power plant.

Ia., Waterloo—Rath Packing Co., Waterloo, bids in June, 4 story, basement packing plant. Approximately $100,000. H. P. Henschein, 59 E. Van Buren St., Chicago, Ill., archt.

Ia., Woodbine—Bids July 1 by City, Power plant building, diesel generating unit, switchboard, and distribution system. $115,000. A. S. Harrington, Baum Bldg., Omaha, Neb., engr.

Kan., Kansas City—Phillips Petroleum Co., Bartlesville, Okla., made plans enlarging refinery, additional stills, lubricating oil equip., tanks, pumps, etc. $800,000. S. Learned, Bartlesville, Okla., engr.

Md., Baltimore—Rustless Iron Corp., 2400 E. Chase St., plans constructing addition to plant. $1,000,000.

Neb., Hastings—Nebraska Refining Co., Hastings, plans constructing oil refinery. $400,000. M. H. Robineau, pres. and genl. mgr.

Neb., Lincoln—Lincoln Cooperative Milk Producers Assn., Lincoln, soon lets contract cons 2 story, 92x125 ft. milk processing plant. $100,000. E. F. Klingler, Amery, Wis., archt.

N. Y., Niagara Falls—New York Power Auth., State Bldg., Albany, making surveys complete, 787,000 hp. hydro-electric plant. Over $50,000,000. G. V. Cruise, c/o owner, chief engineer.

N. C., Asheville—Asheville Coca Cola Bottling Co., plans constructing bottling plant. $125,000. H. I. Gaines, P. Service Bldg., archt.

O., Akron—Quaker Oats Co., 102 South Howard St., plans constructing new giant grain elevator, concrete. $500,000. Private plans.

O., Willard—City plans purchasing, installing turbine and auxiliary equiment at municipal power and light plant. $100,000. W. M. G. Mehl, councilman in charge.

O., Youngstown—K. F. Mogg, Inc., Youngstown, plans by C. H. Reimers. 1293 Chase Ave., Lakewood, altering packing plant, $200,000.

Ore., Springfield—Washington Veneer Co., foot Capitol Way, Olympia, plans constructing veneer manufacturing plant. $500,000. Negotiating with city for site near edge of town.

S. D., Volga—City plans election June 27, to vote $40,000 bonds, power plant and distribution system.

Tenn., Clarksville—B. F. Goodrich Co., H. E. Cook, genl. supt. Eng. Div., 500 South Main St., Akron, O., bids early in June, constructing plant for manufacture mechanical rubber goods, initial unit to include 200,000 sq. ft. floor space, power house, shop buildings and other miscellaneous structures, etc. Total est. $1,500,000. Private plans.

Tex., Borger—Phillips Petroleum Co., Bartlesville, Okla., plans enlarging refinery, additional stills, boilers, pumps, tanks and storage equipment. $750,000. S. Learned, Bartlesville Okla., engr.

Tex., Henderson—B. Franklin, Kilgore, making sketches constructing oil refinery plant, near here. $150,000.

Tex., Houston—Pittsburgh Plate Glass Co. Liberty & Hempstead Roads, Houston, purchased 21 acre site and plans constructing paint manufacturing plant and glass works. $500,000.

Wis., Kaukauna—City—Municipal Utilities making plans constructing hydro-electric plant. $475,000. Mead, Ward & Hunt, 115 S. Carroll St., Madison.

Wis., Madison—Fauerbach Brewing Co., 651 Williamson St., plans constructing new brewery building, $175,000.

Alta., Fort Norman—Imperial Oil Co., Ltd., L. V. Love, executive mgr., making plans constructing refinery extension. $300,000. Private plans.

Alta., Waterways — Scientific Equipment Ltd., R. W. Roso, mgr., Regina, Sask., preparing plans constructing plant for extraction oil and other products from tar sands, $100,000. Private plans.

Man., St. Boniface—Maple Leaf Milling Co., Ltd., Union Trust Bldg., Winnipeg, plans constructing flour mill. $250,000.

Man., Winnipeg—Manitoba Sugar Co., Ltd., W. H. Carter, pres., Royal Bank Bldg., plans nearing completion, constructing sugar beet factory. $1,600,000.

Ont., Kingston—Aluminum Co. of Canada, Ltd., 1010 Ste. Catherine St., West Montreal, Que., plans constructing factory to manufacture aluminum sheets for airplanes. 2,300 tons structural steel to Hamilton Bridge Co., Ltd., Bay St. North Hamilton, $260,000. Total est. $500,000.

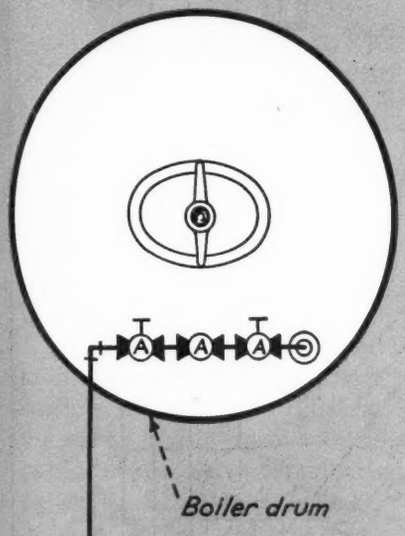
Ont., Port Arthur—Canada Creosoting Co., Port Arthur and 606 Cathcart St., Montreal, Que., plans constructing factory, storage tanks and tar products distillery. $200,000. Private plans.

Que., Levis—Georges L'Hor Co., Angleur-le-Leige, Belgium, made plans constructing aluminum plant. $300,000. Private plans.

. . . TO *GOOD* VALVE PRACTICE

Jenkins RECOMMENDS . . .

FEED PIPING

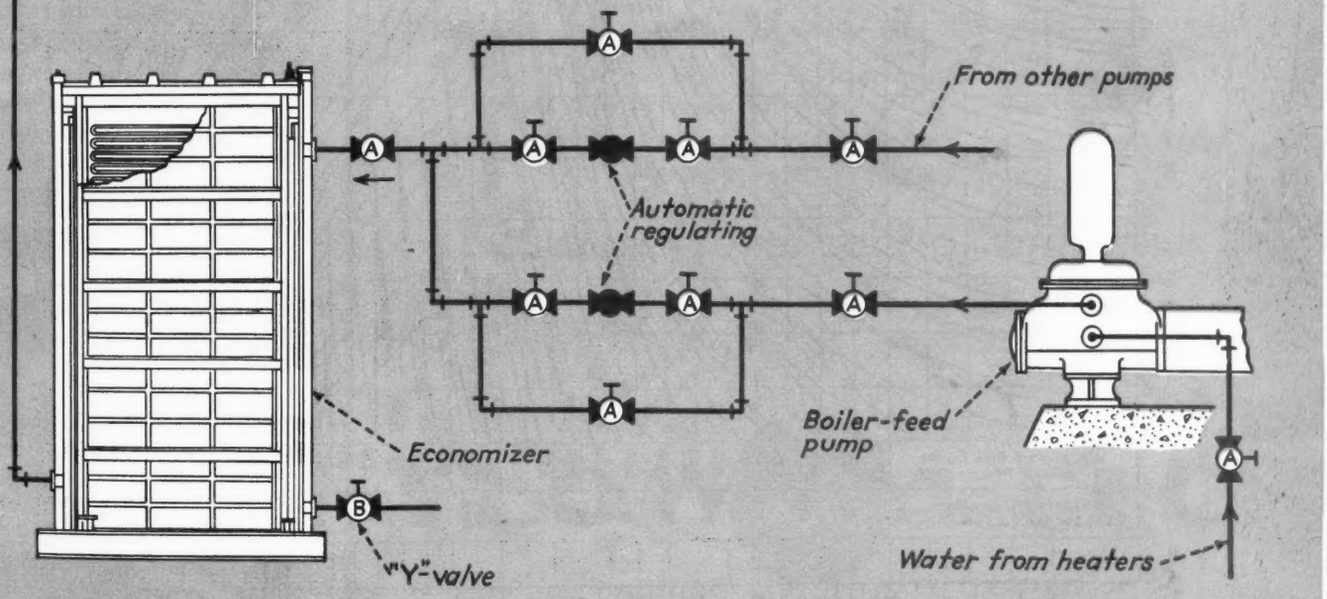


REFERENCE CHART FOR JENKINS FIGURE NUMBERS

While Economizer Connections, Feed Water, etc. are usual in the lower pressures, we have listed valves to include Extra Heavy.

		Standard	Medium	Extra Heavy
A	FEED WATER REGULATOR AND PIPING GLOBE.....	BRONZE 106A Sc. Disc Type 107A Fl. Disc Type 750 Sc. Regrinding 751 Fl. Regrinding 950 Sc. Regr.-Renew 951 Fl. Regr.-Renew IRON 612 Sc. Regrinding 613 Fl. Regrinding 141 Sc. Disc Type 142 Fl. Disc Type	BRONZE 801 Sc. Disc Type 802 Fl. Disc Type 971 Fl. Regr.-Renew 1140 Sc. Regrinding 1150 Sc. Regr.-Renew 1151 Fl. Regr.-Renew IRON 918 Sc. Regrinding 919 Fl. Regrinding 774 Sc. Disc Type 775 Fl. Disc Type	BRONZE 970 Sc. Regr.-Renew 982 Sc. Regr.-Renew Bolted Bonn. 983 Fl. Regr.-Renew Bolted Bonn. IRON 922 Sc. Regrinding 923 Fl. Regrinding 162A Sc. Disc Type 162 Fl. Disc Type
	GATE.....	BRONZE 47 Sc. Travel. Spind. 49 Sc. Travel. Spind. 370 Sc. Non-Rising 670 Sc. Non-Rising 368 Sc. O.S. & Y. IRON 325 Sc. Non-Rising 326 Fl. Non-Rising 650 Sc. O.S. & Y. 651 Fl. O.S. & Y.	BRONZE 270 Sc. Non-Rising 275 Sc. O.S. & Y. IRON 251 Sc. Non-Rising 255 Fl. Non-Rising 277 Sc. O.S. & Y. 253 Fl. O.S. & Y.	BRONZE 280 Sc. Non-Rising 282 Sc. O.S. & Y. IRON 203A Sc. Non-Rising 203 Fl. Non-Rising 204A Sc. O.S. & Y. 204 Fl. O.S. & Y.
	SWING CHECK.....	BRONZE 352 Sc. Disc Type 353 Fl. Disc Type 762 Sc. Regrinding 763 Fl. Regrinding IRON 623 Sc. Regrinding 624 Fl. Regrinding	BRONZE 262 Fl. Disc Type 963 Fl. Regrinding 762 Sc. Regrinding IRON 294 Sc. Disc Type 295 Fl. Disc Type	BRONZE 260 Sc. Disc Type 962 Sc. Regrinding IRON 338 Sc. Disc Type 339 Fl. Disc Type
	HORIZONTAL LIFT CHECK.....	BRONZE 117A Sc. Disc Type 316A Fl. Disc Type 756 Sc. Regrinding 757 Fl. Regrinding IRON 151 Sc. Disc Type 153 Fl. Disc Type 928 Sc. Regrinding 929 Fl. Regrinding	BRONZE 807 Sc. Disc Type 808 Fl. Disc Type 967 Sc. Regr.-Renew 995 Fl. Regr.-Renew Bolted Cover IRON 151 Sc. Disc Type 153 Fl. Disc Type 928 Sc. Regrinding 929 Fl. Regrinding	BRONZE 263 Sc. Disc Type 133 Fl. Disc Type 966 Sc. Regr.-Renew 994 Sc. Regr.-Renew Bolted Cover IRON 265 Sc. Disc Type 266 Fl. Disc Type 934 Sc. Regrinding 935 Fl. Regrinding
B	BLOW DOWN "Y" VALVES	BRONZE 124 Sc. Disc Type IRON 296 Sc. Disc Type 297 Fl. Disc Type	BRONZE 134 Sc. Disc Type IRON 336 Sc. Disc Type 337 Fl. Disc Type	BRONZE 134 Sc. Disc Type IRON 336 Sc. Disc Type 337 Fl. Disc Type

Motor-Operated Iron and Steel Valves can be supplied.



JENKINS BROS., 80 WHITE STREET, NEW YORK, N. Y.

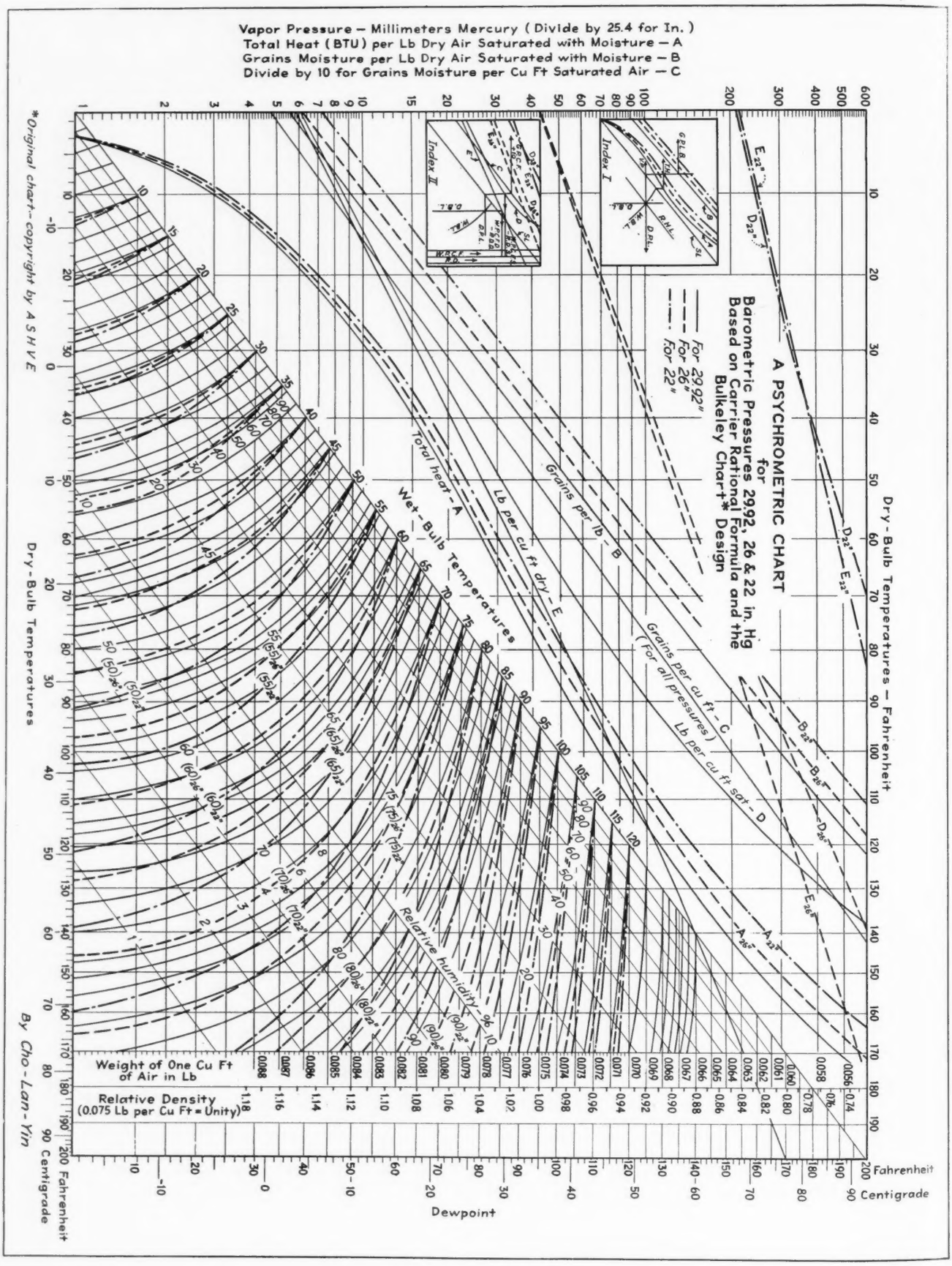
Bridgeport • Boston • Chicago — Philadelphia • Atlanta • Houston

1864—1939 DIAMOND ANNIVERSARY

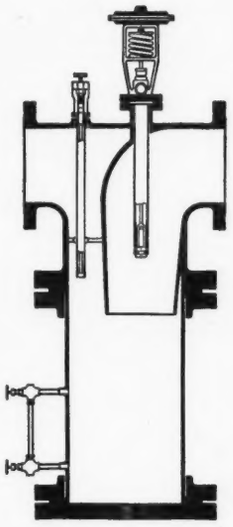
#7 OF A SERIES designed to help in your selection of JENKINS VALVES

Number 84

Psychrometric Chart for High Altitudes


Vapor Pressure — Millimeters Mercury (Divide by 25.4 for In.)
Total Heat (BTU) per Lb Dry Air Saturated with Moisture — A
Grains Moisture per Lb Dry Air Saturated with Moisture — B
Divide by 10 for Grains Moisture per Cu Ft Saturated Air — C
A PSYCHROMETRIC CHART
for
Barometric Pressures 29.92, 26 & 22 in. Hg
Based on Carrier Rational Formula and the
Bulkeley Chart* Design
For 29.92"
For 26"
For 22"
Index I
Index II
Total heat - A
Wet-Bulb Temperatures
Grains per lb - B
Lb per cu ft dry - E
Grains per cu ft - C
(For all pressures)
Lb per cu ft sat - D
Relative humidity
Dry-Bulb Temperatures
Dry-Bulb Temperatures - Fahrenheit
Weight of One Cu Ft of Air in Lb
Relative Density (0.075 Lb per Cu Ft = Unity)
Dewpoint
Fahrenheit
Centigrade
*Original chart - copyright by A S H V E
By Cho-Lan-Yin

The COPES DESUPERHEATER



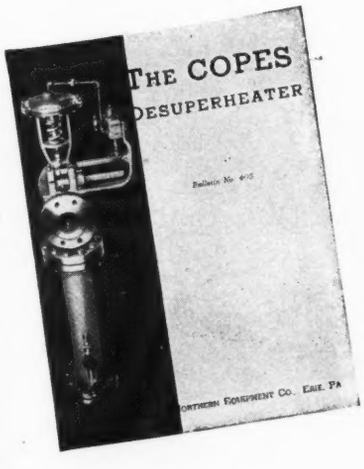
Accurate for total or partial desuperheating, on steam from 212 to 1100 degrees F. Dependable for all flows, regardless of any change in the temperature of the superheated steam entering the unit.

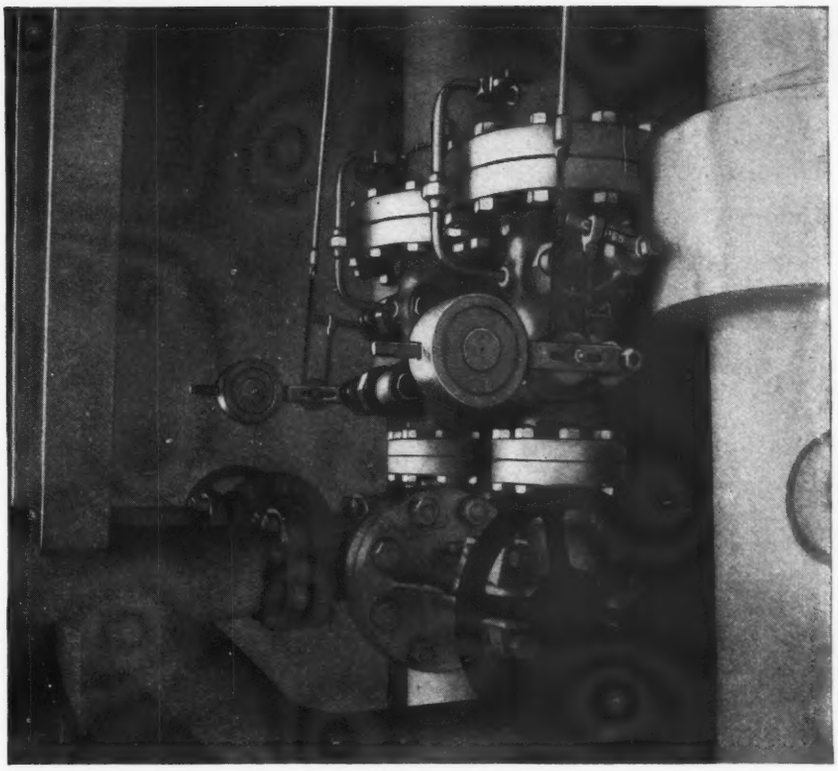
Water correctly proportioned to steam at all times because cooling water is controlled at the spray nozzle—not by any outside control valve. Final temperature held within close limits, because cooling water is completely atomized.

A self-contained unit, with a simple external adjustment for temperatures and sensitivity.

For complete information—

Write for Bulletin 405





At Baldwin Rubber Company:

"Without such instantaneous and accurate response of the feed control valve to the constantly changing load and level conditions, it would have been impossible to operate the plant at the high average efficiency of approximately 84 percent." Baldwin Rubber Company made this report on COPES Flowmatic Regulator performace with loads swinging sharply over an almost 3-to-1 range. For the complete story of accurate feed and level control, write for illustrated Bulletin 419.

NORTHERN EQUIPMENT CO., 711 GROVE DRIVE, ERIE, PA.

Feed Water Regulators, Pump Governors, Differential Valves
Liquid Level Controls, Reducing Valves and Desuperheaters

BRANCH PLANTS IN CANADA, ENGLAND, FRANCE, GERMANY AND ITALY
REPRESENTATIVES EVERYWHERE

Get closer level control with the

COPES

FEEDS BOILER ACCORDING TO STEAM FLOW•AUTOMATICALLY

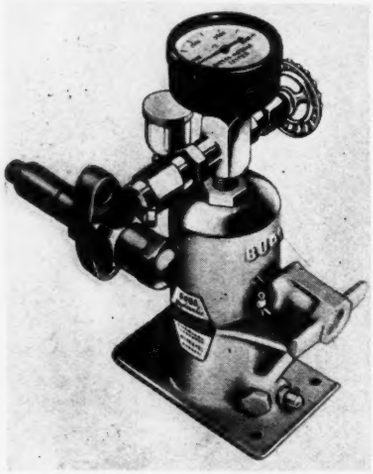
FLOWMATIC

★ REGULATOR

What's New in Plant Equipment

Diesel Nozzle Tester

HYDRAULIC TESTER can be used to test and clean diesel fuel-injection nozzles made by Bosch, Timken, and numerous others. Has oil capacity for testing 20 to 25 nozzles at one filling, and provision can

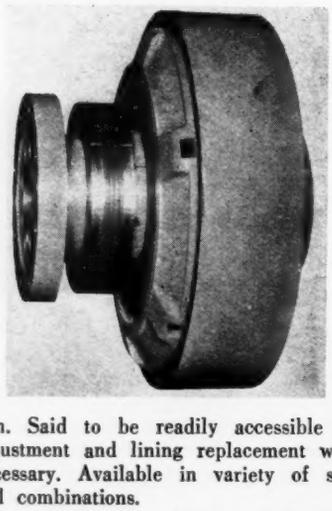


be made to connect to oil-supply tank for continuous operation. Equipped with 2 adapters for specific type of nozzle, and can be secured to bench or packed in case for portable operation.

The Buda Co, Harvey, Ill.

Magnetic Clutch

STYLE F magnetic clutch, illustrated, and Style FF magnetic clutch-brake will fit into small spaces, and speed of operation can be timed to exacting conditions. Applicable to flywheel or shaft application on power presses, die casters, etc. Clutches may be installed in field to replace jaw- or pin-clutches, and are supplied with collector-rings on hub or body of clutch or clutch-brake combina-

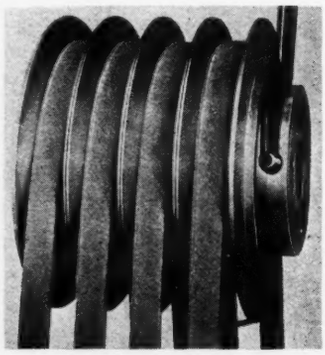


tion. Said to be readily accessible for adjustment and lining replacement when necessary. Available in variety of sizes and combinations.

Stearns Magnetic Mfg Co, Milwaukee, Wis.

Adjustable Pulley

"WEDGBELT" pulley said to eliminate noisy operation and time-taking adjustments, and to provide many speed adjustments between maximum and minimum pulley diameters. On "A" groove, maximum speed changes range from 22 to 33%; "B" groove, 18 to 25%; "C" groove 15 to 20%. By use of adjustable pulleys on both



motor and shaft, greater ratios of speed can be obtained. Side walls of pulleys move in or out simultaneously and are said to produce perfect belt alignment, which is maintained at fast or slow speeds.

American Pulley Co, Philadelphia, Pa.

Hard Rubber Filter

MICROPOROUS hard rubber, used as filter diaphragm, contains continuous network of microscopic pores and is a form of Ebonite. Said to have high degree of porosity not available with any type of woven fabric, and has normal corrosion-resistance of Ebonite. Tear-resistance adequate, and bursting-strength claimed to withstand ordinary conditions of service. Will be available in widths up to 50 in., lengths up to 100 yds, and gages from .030 in. to .100 in. For filtration work under pressure, material is made up reinforced with woven asbestos or stainless steel, providing greater tear resistance and bursting strength without reducing permeability.

U S Rubber Co, Mechanical Div, 1790 Broadway, New York, N. Y.

Aluminum Paint

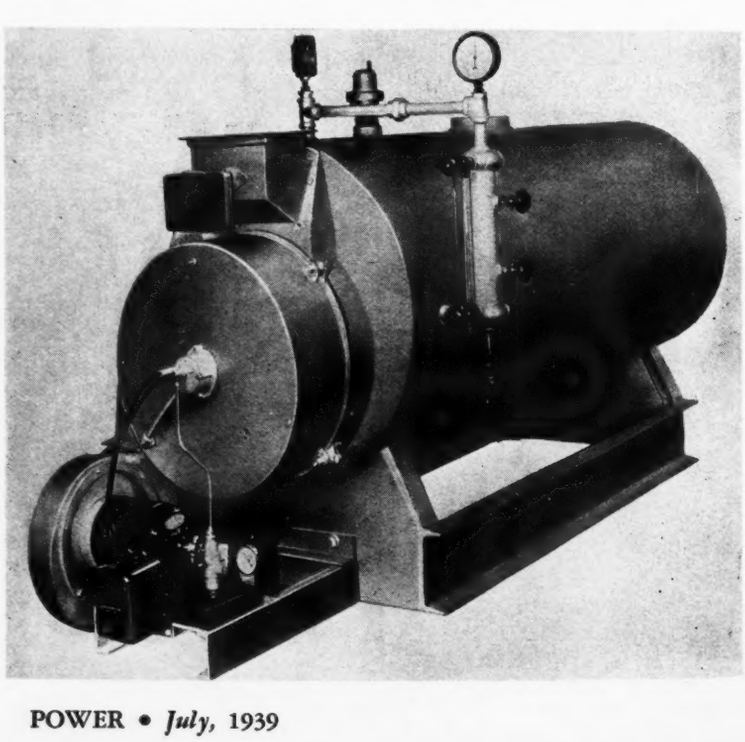
READY-MIXED paint can be applied directly from container. Consists of 99.5% Gilsonite Asphalt and tung-oil base with fine aluminum paste. Tests point out that ready-mixed formula is equal to regular paint in durability. Claimed to be adaptable for those requiring speed and convenience in painting.

American Asphalt Paint Co, 43 E Ohio St, Chicago, Ill.

Burner-Boiler Unit *(below)*

"CYCLOTHERM" utilizes cyclonic principle of combustion and heat-transfer. Unit is complete, ready for installation when shipped, and available in models firing light fuel oil, and above 700-sq ft heating surface. Boilers made in six standard sizes equipped with automatic controls, may be fired by gas as well as oil, operate at positive pressure, and no stack draft is necessary to proper operation of unit. Specifications include high rate of heat absorption.

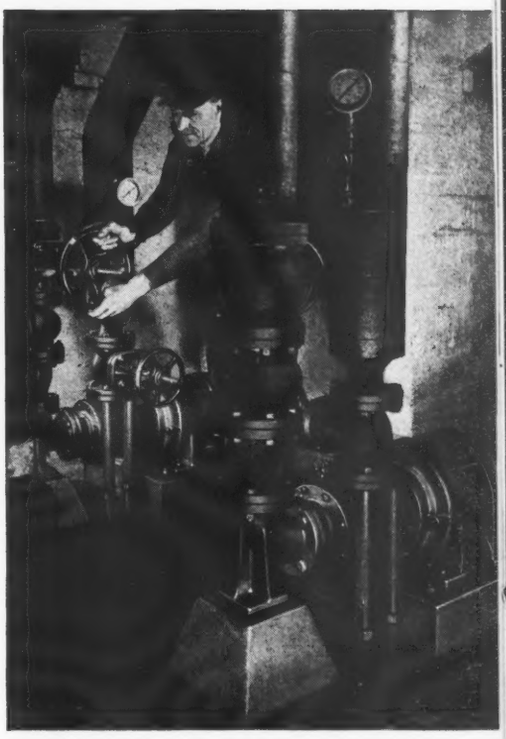
General Furnaces Corp, 17 State St, New York, N. Y.



EXTRA VALUE FEATURES IN SSUNIT PUMPS MEAN

RECORD PUMPING ECONOMY FOR YOU!

Dollar for Dollar, Plants All Over the Country Get the Kind of Record-Breaking Pumping Performance that Makes Allis-Chalmers SSUnits Their First Choice!



IN THIS LARGE MIDWESTERN INdustrial plant, Allis-Chalmers SSUnit Pumps are playing a vital part in holding pumping costs to a new low.

It means pumping costs are knocked down to a new low . . . the way this fast-selling SSUnit pump performs in plants all over the country!

And yet it's only one of the reasons plant managers are switching to the pump Allis-Chalmers engineers — the same engineers who designed and built the gigantic Boulder Dam and Niagara Falls Turbines — originated in 1926 to revolutionize pumping practice . . . actually do away with old, money-wasting pumping methods!

Great Engineering Features! The new SSUnit pump is amazing them with its great engineering features! They call it outstanding . . . for its simple, compact design that beats space waste, cuts maintenance costs . . . for the complete protection against excessive wear and rust that bronze construction gives the enclosed runner, shaft sleeves, and wearing rings!

More Gallons with SSUnits! And they're 100 percent sold on the famous Allis-Chalmers Lo-Maintenance Motor that drives the pump . . . the Full-Measure Constructed Motor that's made a name for itself by standing up under conditions that many times wreck ordinary motors in a few weeks! No "buck-passing"...Allis-Chalmers accepts undivided responsibility for both motor and pump!

That's what they get when they install SSUnit Pumps in their plants! And that's what you'll get, too! But equally important . . . you get a pumping unit that's fully tested before it leaves the factory . . . your guarantee that it's ready to go to work for you the minute it's installed!

Get the whole story on the pump that gives you more gallons at less cost! Call the nearest district office . . . or write direct to Allis-Chalmers!

1108

. . . 90 Years of Engineering Superiority Work for You When You Specify Allis-Chalmers!

CENTRIFUGAL PUMP DIVISION

ALLIS-CHALMERS

MILWAUKEE · WISCONSIN

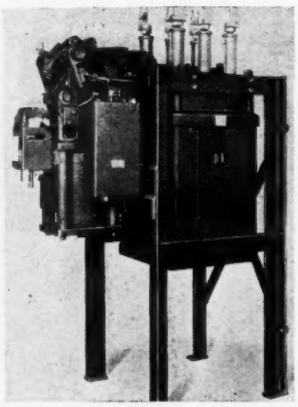
Insulated Pipe Units

METAL CONDUIT system is self-contained sectional system of assembled units including steam pipe, supports, insulation, metal conduit housing, and all accessories, delivered in pre-fabricated form ready for welding. Conduit is spirally corrugated heavy-gage pipe of ingot iron, asphalt coated. Units supplied for either single or multiple pipelines in standard 20-ft lengths, insulation is 85% asbestos, and all units may be laid in shallow trenches, moved or rearranged.

Ric-wiL Co, Cleveland, Ohio.

Oil Circuit Breaker

HORIZONTAL AXIS of Type KDZ-40 is perpendicular to operating mechanism, arrangement of bushings eliminating necessity of crossing leads in certain applications of open and closed-type switchboards. Comes equipped with "Ruptors", special devices used to give efficient interruption



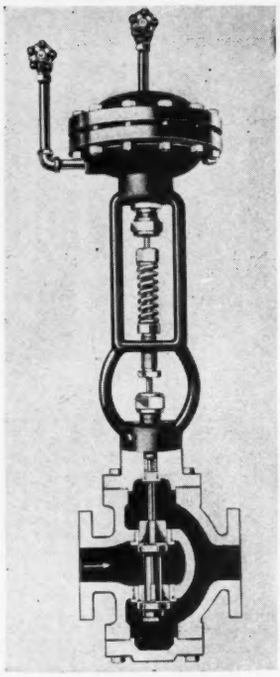
of short circuits along with low arc energy, low pressure, and small oil deterioration. Other features include enclosed low-inertia high-speed mechanisms, internal hydraulic shock absorbers, silvered contacts, oil and gas separators, and Bakelain bushings. Furnished for 600 and 1200 amp at 15 kv, and 2000 amp at 7.5 kv. Interrupting capacity rating is 100,000 kva, arranged for flat-surface mounting, and for mounting in cells, switchhouses, cubicles, metal-clad switching equipment, and safety-enclosed switchboards.

Allis-Chalmers Mfg Co, Milwaukee, Wis.

Duplex Welding Hose

IN CONSTRUCTION of "Condor" duplex hose, two hose lines are held together by permanent web joint, integrally molded, and said to have great strength and flexibility. Joint prevents tangling, kinking and snagging while in use. Ends are separated 18 in. at torch end and 24 in. at tank end, for making connections. Can be obtained in one or two braid, or in spiral cord heavy-duty braid. Covers are corrugated and furnished in red and green to distinguish oxygen from acetylene.

Manhattan Rubber Mfg Div, Passaic, N. J.



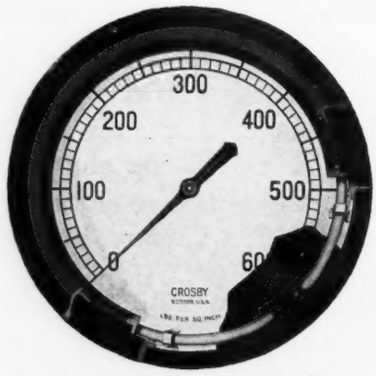
Differential Pump Governor

TYPE 445 governor is designed to maintain differential pressure setting of a system by relieving excess pressure in the discharge back to the suction side. It is installed in the line connecting pump discharge with the suction and is suitable for differential pressures ranging from 10 to 100 lb per sq in. and for working pressures up to 1000 lb, 100 F. The long calibrated steel spring which opposes the differential pressure on the diaphragm gives easy throttling control.

Fisher Governor Co, Marshalltown, Iowa.

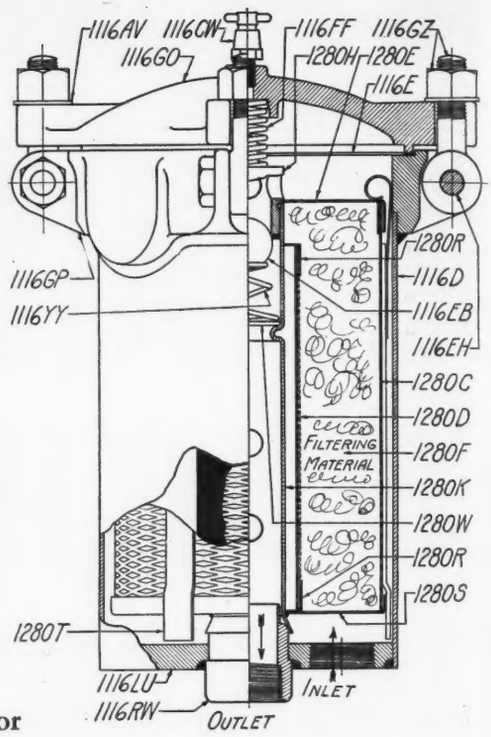
Illuminated Dials

DIALS on standard gage are illuminated by circular neon-type tube attached to ring which diffuses light over entire dial, said to eliminate shadows and glare. Can be furnished on any standard Crosby gage in 10- and 12-in. sizes. Operating parts,



including transformer and illuminating tube, are contained within case. Tube is mounted in front of dial and is attached to reflector ring by spring clips, both removable for inspection. Tube terminals make contact in plug-type base, eliminating wire connections.

Crosby Steam Gage & Valve Co, Boston, Mass.



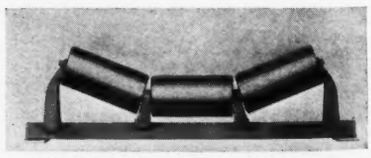
Absorbent Type Filter

IMPROVED DESIGN of filter has more filtering surface, bypass relief valve in same container and easier access to insert or remove filtering medium. Material is stuffed into removable lattice metal cage, and dirty waste is shaken out of cage after center core is removed. Filter may be installed horizontally or at an angle, fixed spring in cover holding cartridge tightly on outlet seat. Filters for use with lubricating oil are usually installed to operate on bypass principle. In pressure lubricating system, oil in circulation is piped to and from the filter, about 1/6 to ¼ of circulated oil passes through filtering material and balance is shunted through relief bypass valve in filter, total amount passing from filter outlet to bearings. Waste cartridge interchangeable with bag type cartridge used in other models, shell being same in both models.

Wm W Nugent & Co, 402 N Hermitage Ave, Chicago, Ill.

Belt Idler

"SERIES 43" belt idlers have self-cleaning bases, and support brackets are assembled in jigs to assure proper alignment and correct spacing. Slight adjustments pos-



sible by slotted holes in mounting plates. Rolls are machine-faced on ends and pressed onto shoulders of cast roll ends, which have been rounded to avoid injury to belt. Grease tube provided from one bearing to the other, and anti-friction

TYPE CP STEAM GENERATOR

KEELER

Highest EFFICIENCY

Featuring

- WATER COOLED FURNACE
- ELIMINATION OF EXPENSIVE BRICKWORK
- MORE CAPACITY PER GIVEN SPACE
- LESS HEADROOM REQUIRED
- LOWER TOTAL INITIAL COSTS

3—350 H. P. "CP" UNITS, HAHNEMANN HOSPITAL PHILADELPHIA, PA.

FUEL SAVING!

SCHOOLS
HOSPITALS
OFFICE BUILDINGS
INDUSTRIAL PLANTS

00 H. P. "CP" UNITS
EORGE SCHOOL
LANGHORNE, PA.

Also Manufactured in Canada by Canadian Vickers, Ltd., Montreal

SEND FOR BULLETIN, S-9

E. KEELER COMPANY

WILLIAMSPORT, PA.

NAME.....

POSITION.....

FIRM NAME.....

ADDRESS.....

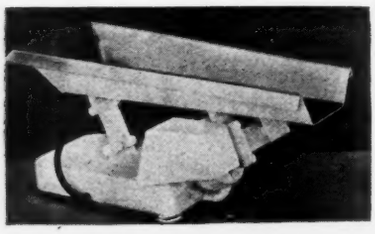
CITY ..... STATE

bearings protected with labyrinth grease seals. Bulletin 80.

C O Bartlett & Snow Co, Cleveland, Ohio.

Vibratory Feeder

MODEL F-O feeder is rated at capacity of handling as much as 2000 lb per hr of



100-lb material, and is intended for small, finely controlled feeds of a few lb per hr. Feeder is made of sheet-metal trough 18-in. long by 3-in. wide, with tapered sides from rear to front, mounted on springs and actuated by pulsating electro-magnet. Control is accomplished by regulating vibratory action through rheostat in separate controller. Controller also contains operating switch and thermionic valve, and is arranged for wall mounting.

Syntron Co, 492 Lexington Ave, Homer City, Pa.

Continuous Boiler Blow-off

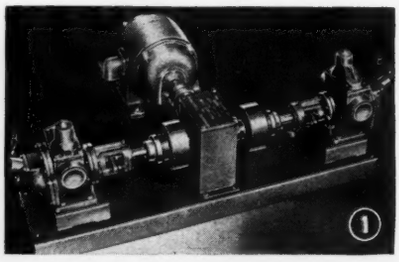
"MULTOMETER" system consists of hollow cone with integral stem forged in one

piece of stainless steel, precision ground and lapped into conical shell of malleable iron. When assembled, cone is held on seat by steel spring, and is made with one blank (or OFF) position, and 9 calibrated orifices, graduated in size to cover any range of flow. Adaptable for use on any boilers operating at pressures up to 250 lb, attached to side or rear of boiler.

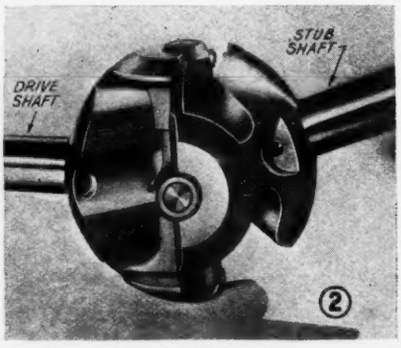
P E Madden Co, Chicago, Ill.

Bulk Plant Pumping Unit

AUTOMATIC-selector twin pumping unit, Fig. 1, is new application of pumps to bulk gasoline-handling plants and to other services. Each unit comprises a motor and spiral-bevel reduction gear to which two rotary pumps connect through two re-



motely controlled clutches. These clutches permit the operator to connect either pump to the gear and motor from the loading platform. It is not possible to overload the motor because both clutches cannot be engaged at one time. The pumps have a rotor, Fig. 2, that operates on the principle of a universal joint. In the free end of the rotor a stub shaft is sup-



ported in a bearing *B*, Fig. 1, that makes an angle of about 30 deg to the horizontal. Opposite end of rotor is fixed to drive shaft. As rotor revolves, four sets of flat surfaces open and close to produce a pumping action, opening on suction and closing on discharge to give four discharges per revolution. These pumps have been developed particularly for handling petroleum products, operate at speeds of from 500 to 750 rpm, capacity ranges from 60 to 300 gpm at a standard pressure of 50 lb per sq in.

Granberg Equipment, Inc, 4068 Holden St, Oakland, Calif.

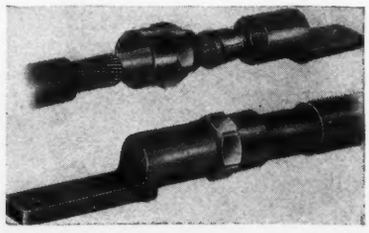
Arc-Welding Electrode

"READYWELD" is low-carbon steel rod with heavy extruded shielded arc coating, and is intended for general repair work on light-gage sheet metal. Electrode said to provide weld-metal which possesses high strength and ductility. Although designed for alternating-current transformer, welders on low open-circuit voltage unit, can be operated with direct-current negative plants. Manufactured in $\frac{3}{32}$-in. dia, 12-in. lengths, and packed in 25-lb containers.

Lincoln Electric Co, 12818 Coit Rd, Cleveland, Ohio.

Hood-Nut Connectors

CONNECTORS developed for use with rubber or compound insulated cables at points where they are joined to other cables, switches, etc. Taping is done from shroud of nut to rubber insulation of cable, pre-

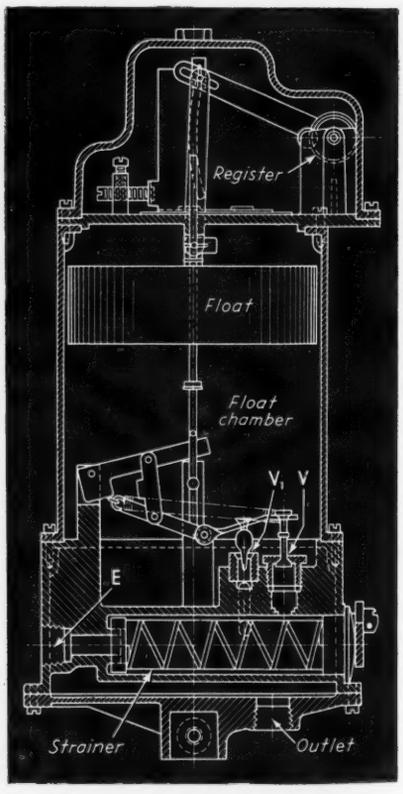


venting entrance of moisture between insulation and conductor. In addition to type illustrated, connectors also furnished in form of T-connectors, straight connectors and in special forms.

Burndy Engrg Co, 459 E 133rd St, New York, N. Y.

Positive-Displacement Flowmeter

POSITIVE-DISPLACEMENT fuel oil meter for use with small- and medium-size oil burners and diesel engines, uses float for measuring in chamber of 0.1-gal. capacity. Oil enters meter at *E*, flows through strainer and valve *V* into measuring cham-

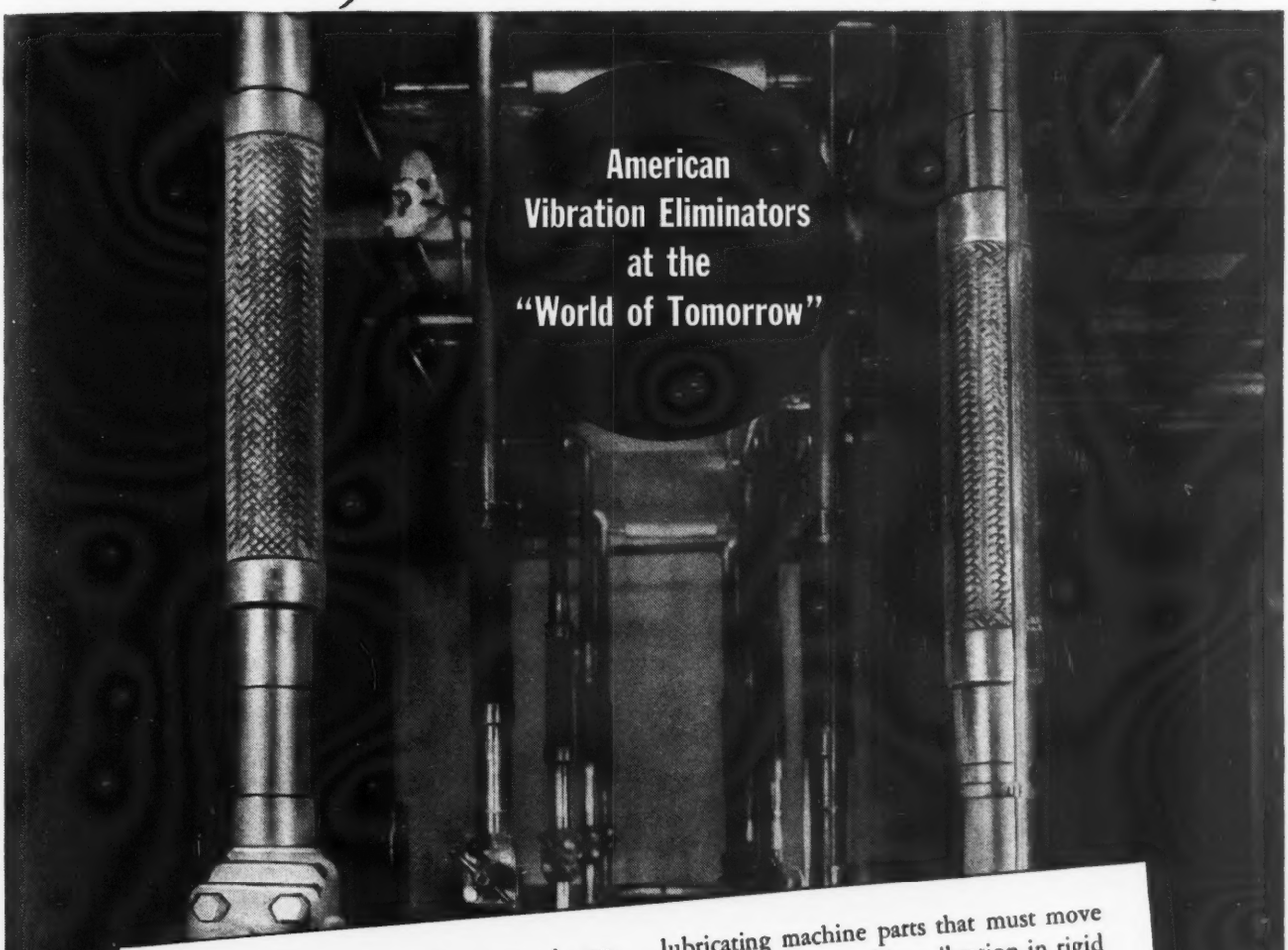


ber. When oil lifts the float to predetermined height, it operates toggle mechanism to close inlet valve *V* and open outlet valve V_1 to let oil run into sump in bottom of meter. When 0.1 gal. runs into sump, float closes valve V_1 and opens *V*

(Continued on page 130)

Modern Solution for many Piping Problems

American Seamless Flexible Metal Tubing



(Above) Partial view of a large air conditioning installation in a prominent building at The New York World's Fair. 38 American Vibration Eliminators were used in this installation.

Wherever you need a flexible connector for liquid or gas lines, consider "American Seamless." Made of strong, *seamless* metal tubes, it has no laps, seams, welds or joints of any kind. It is industry's best bet in thousands of applications for carrying steam, oil, air, liquids and gases for heating, cooling or lubricating machine parts that must move frequently; for absorbing vibration in rigid pipe lines; for quick and economical connection of misaligned parts.

When you have a flexible connector problem of any kind, put it up to our Engineering Department. 39238

Write now for free copy of this new 24-page manual—most complete ever published on Seamless Flexible Metal Tubing. Ask for catalog SS-25-H.

American Metal Hose

ANACONDA from mine to consumer

AMERICAN METAL HOSE BRANCH OF THE AMERICAN BRASS CO.
General Offices: Waterbury Conn. *Subsidiary of Anaconda Copper Mining Company*
In Canada: ANACONDA AMERICAN BRASS LTD., New Toronto, Ont.

Lookee Here, Dam Ye! . . .

I WAS TALKING to my Uncle Joe, a hard-headed old codger if there ever was one. He was sitting in his office, because he was "Supe" at his plant, when the General Manager stuck his head in. "Joe," says the G.M., "What's our cost per unit?"

Uncle Joe didn't bat an eye; he just opened a desk drawer, looked into a folder, and said, "Twenty-one and a half cents."

Now that was the third question like that somebody had asked while I'd been there, and Uncle Joe had batted off the answers like he was on that radio program, "Information, Please." Every time, he referred to that desk file of his, so I said, "Uncle Joe, what have you got in there, a fortune teller or a lightning calculator?"

"Neither," says Uncle Joe, "I call that my *Lookee here, Dam ye!* file, because it's got all the things in it they're likely to ask about and a whole lot more. When they spring a tough one on me, I just look up the answer, and say, 'Lookee here, Dam ye!'

"When I was a young buck around here, somebody was always asking me questions I couldn't answer. So I started to keep my own records. Sure, the planning department had some of the dope, the engineering department some, and the production department most of the rest, but in spite of that, a lot of the Brass Hats used to ask somebody else. I decided that I'd have every answer if I got asked—nobody was going to catch me with my pants down."

Uncle Joe gave me an idea right there—an idea that's saved me all kinds of trouble since. You'll find the same kind of file in my desk now.

I'm passing the idea on to you for what it's worth. Keep a file if you want to, or keep a little black book in your pocket, but put down the essential records someplace where you can get at 'em without hunting up the watch engineer or the time kid. Sooner or later, the Brass Hats are going to begin to think you know all the answers, and that never hurts the pay check.

George Edwards

Engineer

GUIDE POSTS TO BETTER DIESEL PERFORMANCE

CAST NICKEL IRONS

DIESEL ENGINE PARTS

PART	KEY LETTER
Base	A,B,L,X
Bed Plate - heavy engine	L,N
Bed Plate - light engine	A,B,X
Cams	H,J,Q
Cams - heavy engine	G
Camshafts - heat treated	Q,S
Connecting Rod Shoes, Guides	C
Cooling Water Circulating Pump Body	A,R,T
Cooling Water Circulating Pump Impeller	A,R,T
Crankcase	A,B,C,L,X
Crankshaft	S
Cylinder Blocks, Bodies, Frames - heavy engine	C,D,L
Cylinder Liners, for use with above	B,C,M
Cylinder Blocks, Bodies, Frames - light engine	A,E,K
Cylinder Liners, for use with above	A,E,K,R
Cylinder Blocks, Bodies, Frames - high strength	B,R
Cylinder Heads - heavy engine - high strength	M
Cylinder Heads - medium engine	L,P
Cylinder Heads - light engine	A,E,F
Cylinder Heads - light engine - high strength	N
Cylinder Liners - light and medium engines (sand cast, heat treatment optional)	E,P
Cylinder Liners - centrifugally cast, heat treated	A,E,P,R
Cylinder Liners - For use with aluminum blocks and pistons	T
Flywheel	A,B,X
Frame castings - heavy engine	A,B,P,X
Fuel Oil Pump Body	A,R
Housings - heavy engine - see also Frame castings	A,B,P,X
Lubricating Pump Body	A,R
Manifolds	E,P,F,G
Manifolds - water cooled	E,T
Oil Cooler Body	E,T
Pistons - heavy engine	C,M,P
Pistons - heavy and medium engines - high strength	B,N,P
Pistons - light engine	E,K
Piston Crowns - inserts in aluminum pistons - light engine	T
Piston Rings - heavy engine - single cast	A,L,K
Piston Rings - heavy engine - pot cast	B,D,E
Piston Rings - heat treated	E,S
Piston Rings - medium engine - pot cast	A,K
Piston Rings - light engine - pot cast	K,R
Timing Gears	A,K,R
Turbo-Blower Casing	A,K,R
Valves - Cooled cast on head	E,G,T
Valve Guides	E,T
Valve Seats - for use with aluminum heads	T
Valve Seats - heavy engine	E,L

RECOMMENDED COMPOSITIONS AND TYPICAL MECHANICAL PROPERTIES OF NICKEL CAST IRONS FOR DIESEL ENGINE PARTS

KEY LETTER	CHEMICAL COMPOSITION						TYPICAL RANGE OF MECHANICAL PROPERTIES	
	TOTAL CARBON	SILICON	MANGANESE	NICKEL	CHROMIUM	MOLYBDENUM	TENSILE STRENGTH, p.s.i.	BRINELL HARDNESS
A	3.10/3.30	1.40/1.80	0.50/0.80	1.25/1.75	-	-	35,000/40,000	200/240 (7)
B	2.75/3.00	1.30/1.70	0.60/0.90	1.50/2.00	-	-	50,000/60,000	220/260
C	3.00/3.20	1.00/1.40	0.50/0.80	1.00/1.50	-	-	36,000/40,000	200/260
D	3.00/3.20	0.90/1.30	0.50/0.80	1.75/2.25	-	-	38,000/44,000	200/260
E	3.10/3.30	1.70/2.10	0.50/0.80	1.50/2.00	0.40/0.60	-	36,000/40,000	210/250 (7)
F	3.20/3.40	1.90/2.30	0.50/0.80	1.00/1.50	0.40/0.60	-	33,000/38,000	200/240
G	3.10/3.50	1.50/1.80	0.50/0.80	1.75/2.25	0.60/0.75	-	36,000/42,000	220/280
H	3.00/3.20	1.00/1.40	0.60/0.90	2.75/3.25	0.40/0.60	-	45,000/55,000	260/320 (7)
J	3.00/3.20	0.70/0.90	0.60/0.90	1.75/2.25	0.90/1.10	-	35,000/40,000	280/350 (6)
K	3.00/3.30	1.70/2.20	0.50/0.80	0.75/1.25	0.15/0.30	-	33,000/38,000	170/220
L	3.05/3.30	1.00/1.40	0.50/0.80	1.00/1.75	0.30/0.60	(5)	36,000/42,000	220/260
M	2.90/3.10	1.00/1.90	0.60/0.90	1.00/1.50	0.25/0.35	(5)	40,000/50,000	210/260
N	2.70/3.00	1.50/1.90	0.60/0.90	1.75/2.25	0.20/0.40	(5)	50,000/60,000	220/260
P	3.00/3.25	1.30/1.75	0.60/0.90	1.35/1.50	0.30/0.50	0.30/0.60	40,000/50,000	200/260 (7)
Q (3)	3.10/3.40	2.10/2.40	0.50/0.75	0.20/0.40	0.75/1.00	0.40/0.60	50,000/55,000	260/300 (7)
R	3.10/3.30	2.00/2.40	0.50/0.80	1.25/1.75	0.10/0.30	0.30/0.50	45,000/55,000	220/280
S	2.60/3.10	1.90/2.50	0.65/1.00	1.25/1.75	-	0.60/1.00	60,000/70,000	260/300 (7)
T	2.30/3.00	1.00/2.00	1.00/1.50	13.00/16.00 (4)	2.00/5.00	-	22,000/30,000	140/180
I	3.00/3.50	1.00/2.20	0.50/0.80	-	-	-	20,000/30,000	140/180

FOOT-NOTES: (3) Made by Campbell, Wyant and Cannon Foundry Co. (4) Also includes 5.00/7.00% copper. (5) Optional. (6) The chilled surface hardness will be approximately 550 Brinell. (7) Heat treatment optional.

WITH economical Diesel power being applied to many new uses, this summary of Diesel engine materials in actual service can be helpful as a guide and comparison for your specifications. These Nickel cast irons have a background of successful performance under many conditions.

Because Diesel engines vary widely in size and type, more than one Nickel cast iron composition is suggested and your choice will depend upon the size and service requirements of your engine.

Since earliest days of Diesel development, it has been Nickel's privilege to aid in the development of stronger, longer-wearing materials which withstand higher pressures and higher temperatures. Consultation regarding the uses of Nickel is invited.

THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL STREET, NEW YORK, N. Y.

DEPENDABLE SERVICE

You'll have plenty of reasons to be grateful if you install Fairbanks Iron Body Valves. They are sure to give years of trouble-free service, for their quality is deep down and enduring.

The easy manipulation . . . ease of repacking . . . ease of renewing . . . interchangeable parts . . . sturdy construction . . . perfect seating . . . expert workmanship . . . careful testing . . . these are but a few of the features that will appeal to you.

For more than 50 years it has been our constant aim to make valves that satisfy from the standpoint of operation, durability and economy.

Try Fairbanks Valves and you'll be convinced of their superior excellence. Distributors everywhere sell them.

Write for our Catalog No. 21.

THE FAIRBANKS COMPANY
Valves, Dart Unions, Hand Trucks and Wheelbarrows
Executive Office:
397 Lafayette St., New York, N. Y.
Boston, Pittsburgh—
Distributors in Principal Cities
Factories: Binghamton, N. Y. Rome, Ga.

ACME THREADS FOR EASY OPERATION AND STRENGTH
LIBERAL NUMBER OF THROUGH BOLTS
RENEWABLE SEAT AND DISC
DEEP STUFFING BOX WITH FOLLOWER GLAND
TOP SEAT FOR PACKING UNDER PRESSURE WHEN FULLY OPEN
FULL SIZE BODY PASSAGES PERMIT FULL FLOW

Fairbanks
Iron Body Globe
Valves

New Equipment

(Continued from page 126)

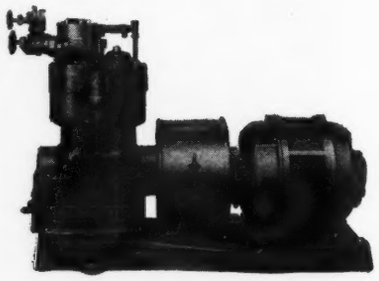
for another charge of oil. Oil piped from sump to burner or engine.

Accuracy guaranteed to be within 3 cu in. in 5 gal. Has capacity of from less than 0.1 gal. to 14 gal. per hr with 8-in. head. May be used with No. 1 to No. 4 oil and heavier oil if preheated. Counter at top of meter registers from 0.1 gal. to 10,000 gal. Meter stands 12 in. high, 5 in. in diameter and weighs 9 lb. Can be used for measuring any liquid of fairly low viscosity.

Fluid Meters, Inc, 44 Wall St, New York, N. Y.

Starting Air Compressor

TYPE 20, vertical, stationary unit is built in four sizes from 7½- to 20-hp for piston displacements of from 29 to 60 cfm at discharge pressures of 300 to 400 lb on

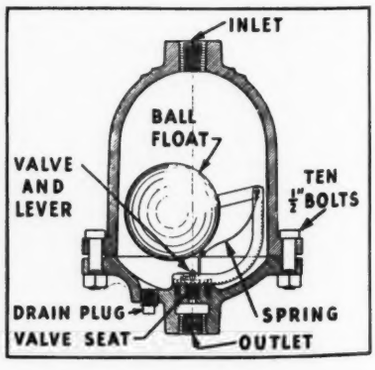


heavy-duty service, and up to 1000 lb on intermittent starting service. Adaptable for starting stationary and marine diesel engines, and are available in variety of drives for connection to electric motor, gasoline or oil engine, flat or V belt. Is water cooled, automatically lubricated; minimum attention requirements claimed.

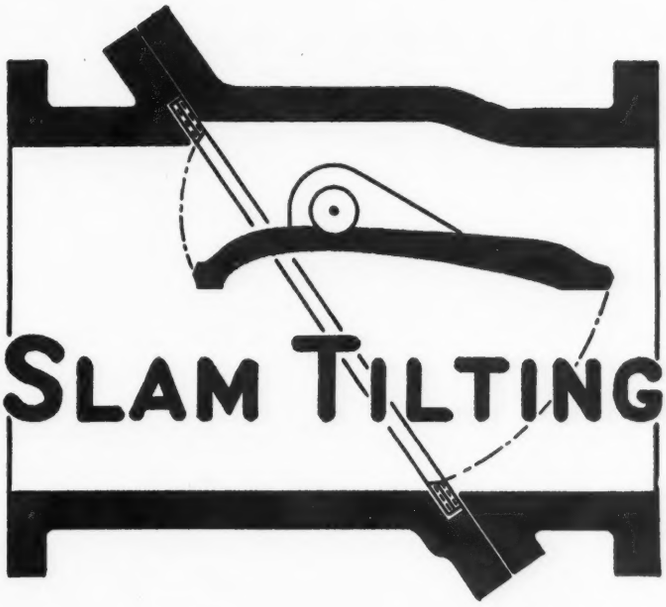
Ingersoll-Rand Co, 11 Broadway, New York, N. Y.

Snap-Action Air Trap

AUTOMATIC mechanical trap is used for draining water from compressed air lines, tanks, separators, and aftercoolers. Principal advantages claimed are immunity to ordinary dirt conditions, ability to discharge water without loss of air, positive opening and closing of discharge-valve, and freedom from need for priming.



Check with Chapman



NON-SLAM TILTING DISC

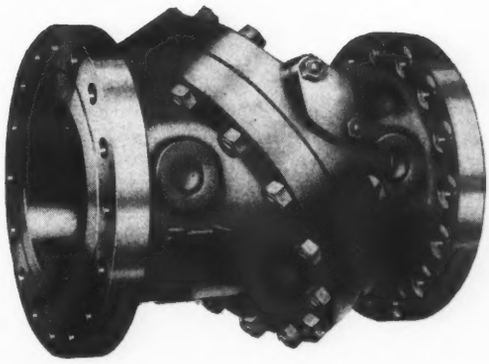
Steel Check Valves

For the Modern Power Plant

Chapman Tilting Disc Check Valves have several important advantages over standard type swing checks, which especially adapt them for power plant use. These advantages result from a radically different principle in the design and operation of the valve which reduces slam, headloss and wear to a minimum, and keeps the valve drop-tight under all pressures.

For the modern power plant, with its higher pressures and exacting requirements, these valves, in Chapman steel or alloys best suited to the specific service required, are especially recommended.

Write for information. It pays to "check" with Chapman.



Typical Chapman Steel Tilting Disc Check Valve

Cost Saving Advantages:

1. **Minimum wear of moving parts**
2. **Absolute tightness**
3. **Closing without slam**
4. **Reduced loss of head**

THE CHAPMAN VALVE

MANUFACTURING COMPANY

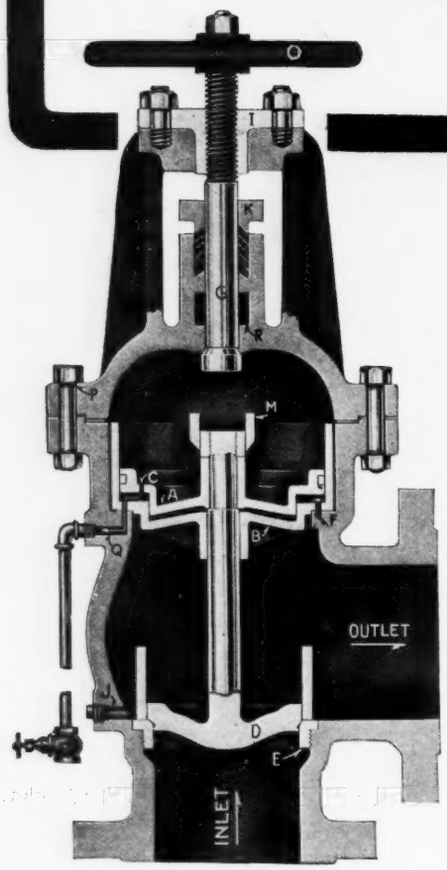
INDIAN ORCHARD, MASS.

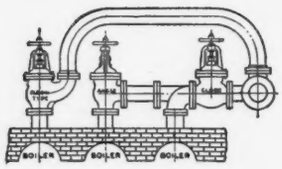
★

Golden-Anderson

SPECIALTY

VALVES





NON-RETURN

When a boiler tube bursts, the controls of every boiler in that battery "explode" through the one bursted tube, leaving destruction and waste in its path. That is, *unless* each boiler is equipped with a good, reliable non-return valve . . . one that will not and cannot stick, such as the G-A Non-Return Valve shown here. Thousands in use, and not one has failed to our knowledge.

For your own safety—of *life* and property—investigate the G-A non-return now.

Write for Catalog

Also

Altitude Control . . .
Pressure Reducing . . .
Throttle and Emergency Stop . . . Check Valves etc.

Golden-Anderson Valve Specialty Co.

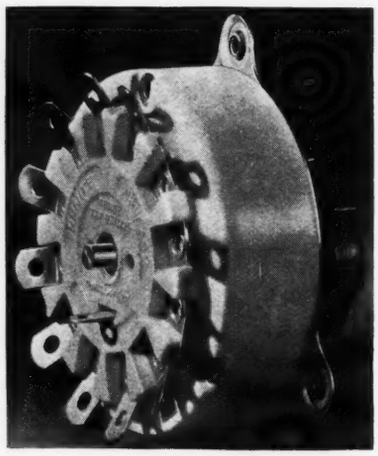
Fulton Bldg. • • • Pittsburgh, Pa.

Trap has ball float, see illustration, which is connected to short valve lever through flat strip of stainless spring steel. In closed position, this spring is bowed downward. As water enters body of trap, ball float rises, bending and storing up energy in the spring. Just before ball float reaches top of trap, spring bends past dead center and stored-up energy snaps valve wide open. In this position, spring is bowed upward. As water level drops in trap body, cycle is reversed and valve snaps shut. Valve is claimed to have capacity of 1400 lbs of water per hr at 125-lb pressure, and 100 lbs per hr at 200-lb pressure.

Armstrong Machine Works, Three Rivers, Mich.

Tap Switch

MODEL 412, 40-amp, heavy-duty, rotary, multi-point selector tap switch is said to provide more practical answer to circuit switching requirements for battery chargers, tapped transformers, arc welders, ventilating fans, and motor control. Model illustrated, rated for 240 v ac non-inductive circuit, is 4-in. in dia, and equipped



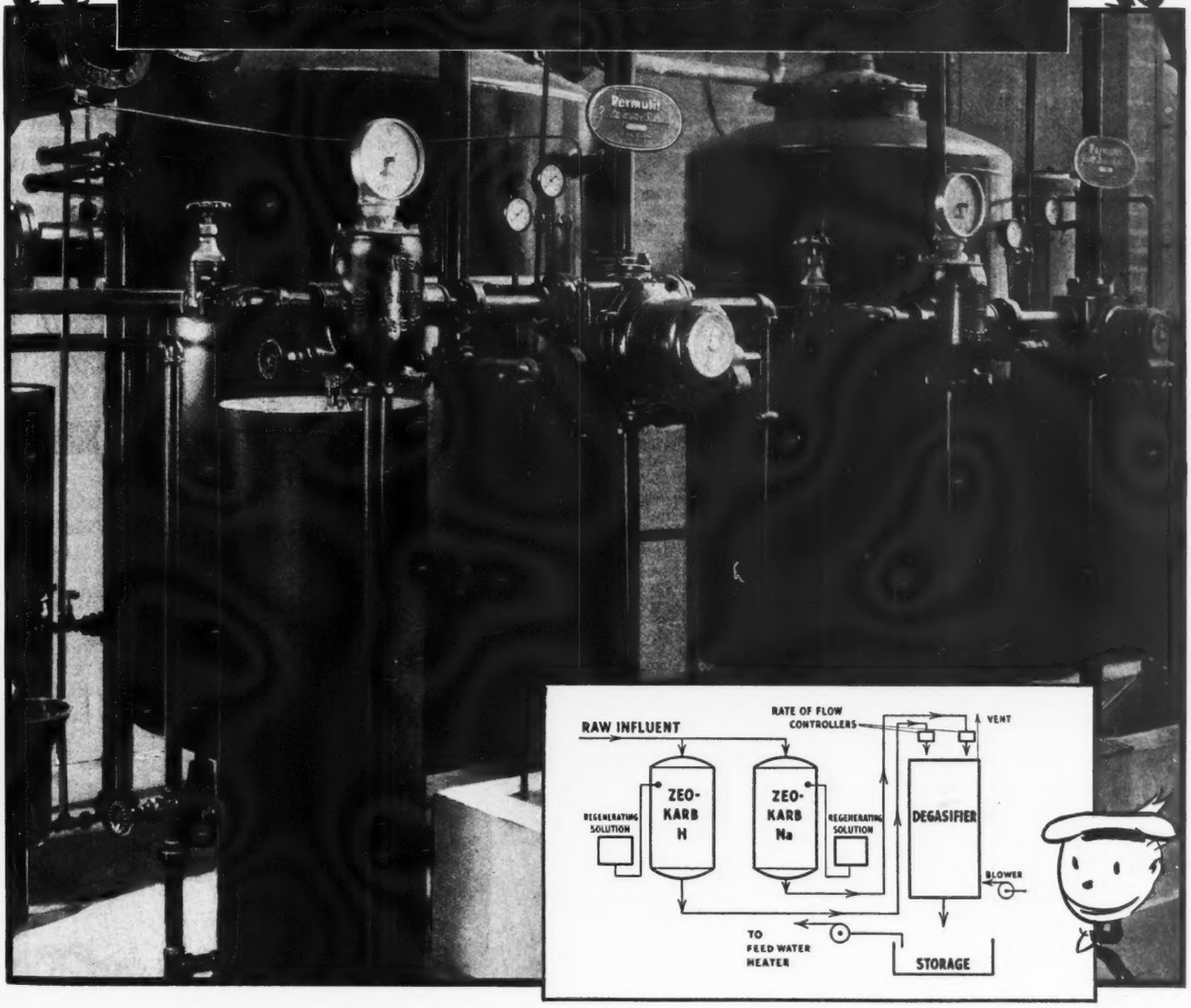
with maximum of 12 contacts. Other features include enclosed porcelain construction, silver-to-silver contacts, all other current-carrying parts silver plated, low contact resistance, positive cam and roller snap action, porcelain high-voltage insulation between contacts and shaft and mounting plate, back-of-panel mounting, and single or tandem mounting.

Ohmite Mfg Co, 4835 Flournoy St, Chicago, Ill.

Variable-Voltage Control

ALL-ELECTRIC ac adjustable-speed drive in small ratings, employing variable-voltage control, comprises 3500-rpm squirrel-cage motor, dc generator and exciter mounted vertically with starting switch. Adjustable-speed dc motor for driving the machine, speed-changing field rheostat, and start-and-stop pushbuttons complete the drive. Brushes on dc generator connect directly to those of dc motor. Exciter connects directly to dc motor field coils and

For High-Pressure Boiler Feedwater
PERMUTIT ZEO-KARB H



DOES ALL THIS BY ION EXCHANGE ALONE:

1. Removes Scale
2. Prevents Sludge
3. Inhibits Corrosion
4. Lowers Alkalinity
5. Reduces Total Dissolved Solids

If your boilers are operating at high ratings and pressure, you know how exacting your feedwater requirements are.

Your make-up water should produce no scale, sludge or corrosion. It should have low sodium carbonate alkalinity and low total solids. Zeo-Karb H is tailor-made for a tough problem like this. A carbonaceous, non-siliceous zeolite, regenerated with acid . . . it's a product of Permutit research.

ZEO-KARB · ZEOLITE AND ACID · HOT LIME SODA LIME ZEOLITE · INTERNAL

A TYPICAL FLOW DIAGRAM of Zeo-Karb in use. By ion exchange alone, Zeo-Karb H converts all bicarbonate hardness into CO_2 and water. Chloride and sulphate hardness is changed to NaCl and Na_2SO_4 in the blended effluents from the H and Na units.

★ ★ ★

FREE...8-PAGE BOOKLET. Authoritative, describes applications of Zeo-Karb feedwater treatment in detail. Get it now . . . no obligation. Address The Permutit Company, Dept. A, 330 West 42nd St., New York.

Permutit
The Water Conditioning Headquarters
over 25 years

GET *Better Control* FOR *Less Money*

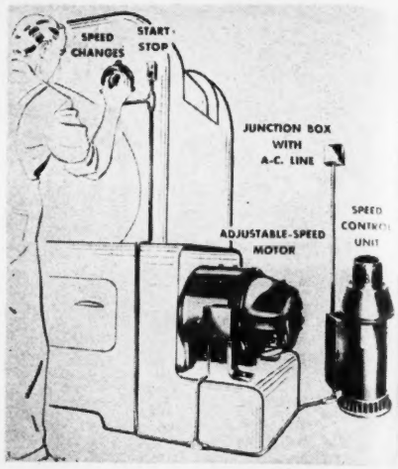
THESE pressure regulators give you accurate control of air, water and steam pressures—saving you money by reducing waste, by cutting maintenance costs and by minimizing time out of service. Your maintenance crew, your production superintendent and your treasurer will all appreciate the extra value built into Masoneilan Regulators. Your mill supply distributor will appreciate the opportunity to give you complete details.

Ask him for Bulletin No. 64—
or write our office nearest you.

1186 ADAMS STREET
BOSTON, MASS., U. S. A.

MASONEILAN
REG. U.S. PAT. OFF.

New York **Buffalo** **Philadelphia** **Pittsburgh**
Chicago **St. Louis** **Tulsa** **Houston** **Los Angeles**

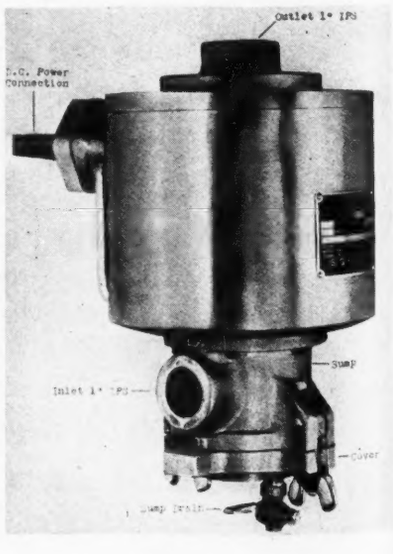


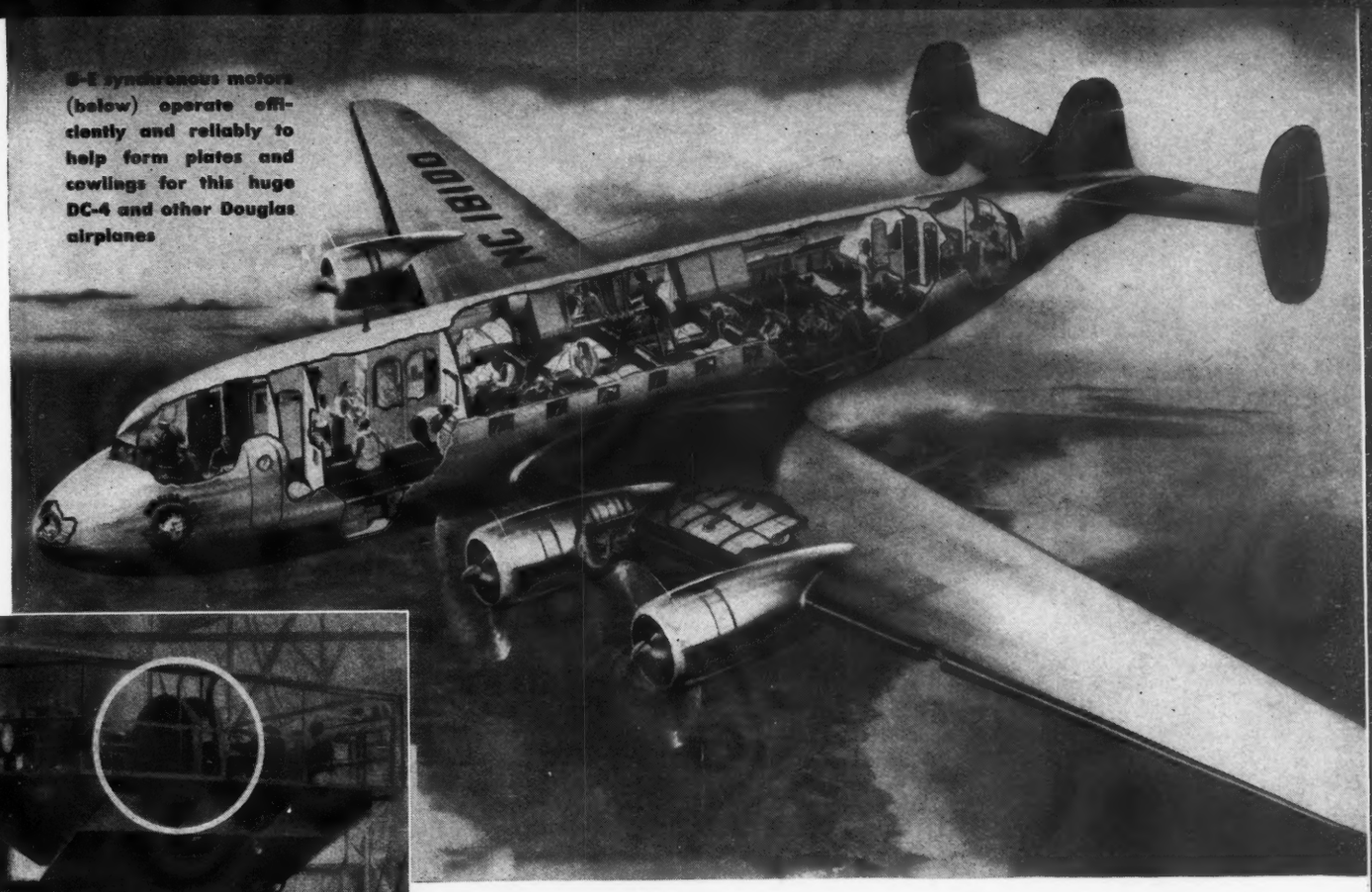
to dc generator field coils with field rheostat in series. All control centered in field rheostat and start and stop pushbuttons, mounted where most convenient for machine operator. Turning field rheostat gives speed range of 12 to 1. Simple addition to stop button provides any desired make-ready speed. Unit size down to 1 hp available, having all advantages of variable-voltage control, heretofore available in medium- and large-size units. Speed-control-unit motor designed for 3-phase, 60-cycle, 220-, 440- and 550-volt circuits. Of vertical construction, forced ventilated, and operating at high speed, it occupies a minimum of floor space. Machine dc drive motor, designed particularly for adjustable-speed service, supplied in a variety of types, including inclosed fan-cooled, splash-proof and explosion-proof.

Reliance Elect & Engrg Co, 1057 Ivanhoe Rd, Cleveland, Ohio.

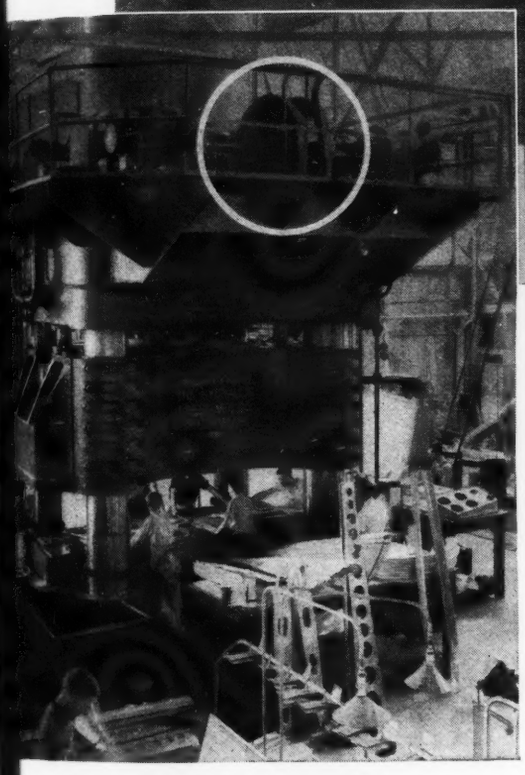
Oil Filter

"FERRO-FILTER", said to remove particles of iron from lubricating oil up to 1/25,000 in., operates on magnetic principle. Consists of set of screens set in a stack, highly magnetized and enclosed in a casing. Screens have mesh openings about ⅛-in., which offer little resistance to oil flow, and said to be non-clogging. Dirt is retained on screen until demagnetized and cleaned.





G-E synchronous motors (below) operate efficiently and reliably to help form plates and cowlings for this huge DC-4 and other Douglas airplanes

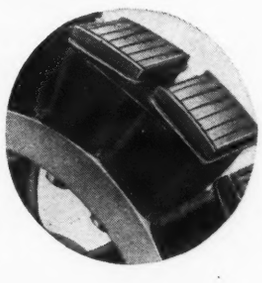


How TWO G-E SYNCHRONOUS MOTORS Helped Build This Hotel-on-Wings

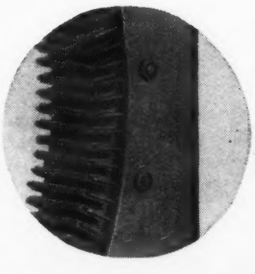
IN ONE of the world's largest aircraft plants—that of the Douglas Aircraft Company of Santa Monica, California—two G-E synchronous motors drive pumps for operating the giant hydraulic press that fabricates plates, cowlings, and other parts for all Douglas airplanes, including this huge DC-4. The two motors have been in operation for more than two years and have proved themselves to be reliable and efficient pump drives. In addition, the Douglas Company has earned approximately $1000 a year in bonuses due to the power-factor improvement made possible by these two motors.

Synchronous motors are the most efficient and reliable drives for many constant-speed applications, such as certain types of compressors and pumps. Their inherent ability to improve power-factor means lower energy charges, lower demand charges, and often, lower power rates. In addition, they assure better operation of all other electric equipment because of improved voltage regulation. The efficiency of the entire distribution system is increased because line losses are minimized.

Why not investigate the possibility of making savings in your own plant through the use of synchronous motors? G-E application engineers will be glad to help you. Call the nearest G-E office, or write General Electric, Schenectady, N. Y.



-E synchronous motors the bars e amortisseur winding are fitted holes in the heavy, sectional- copper end-rings and are -soldered at red heat to form esistance, brazed alloy joints of mechanical strength. This ar- ment permits easy removal of r more field poles without dis- ng the remaining poles

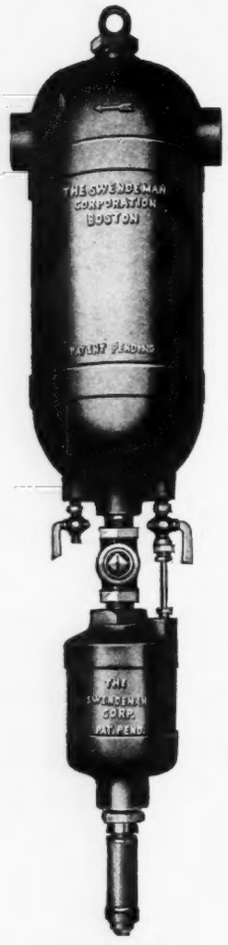


core loss is assured by lamina- of best-grade, nonaging, silicon steel, carefully annealed and eled. Deep, radial I-bars, spot- d to the outside laminations, a uniformly tight core and operation

GENERAL ELECTRIC

040-54

Keep your air lines oil- and water-free . . . . . SWENDEMAN SEPARATORS *do it automatically!*



TYPE C

Devices that simply trap oil and water in compressed air lines *and retain it* will never keep your compressed air lines *absolutely free* from oil and water. During the collection process some of it is bound to get through in the form of moisture.

In modern plants trapping devices that require manual draining are a thing of the past. Swendeman Separators discharge the water and oil as they are precipitated. It is done automatically and efficiently.

The installation is quickly and easily made.

They are made in three types.

TYPE A—used for all classes of industrial work where pressure variations are not necessary.

TYPE C—equipped with shut-off cock to permit of removing valve for cleaning without loss of air. A desirable feature where air is in constant use, particularly on the larger sizes.

TYPE D—has pressure regulator and gauge and is used when pressure regulation is essential, as in spray painting.

(Also manufacturers of the Dexter Valve Reseating Machines for reseating globe valves, gate valves and pump valve seats.)

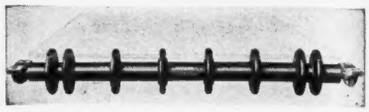
THE LEAVITT MACHINE CO.
10 EAST RIVER ST. ORANGE, MASS.
Canadian Distributors:—
The Canadian Fairbanks-Morse Company Limited
15 Branches Throughout Canada

Cleaning is done by washing in gasoline, and no fillers or other replacement parts are necessary. Low pressure-drop through filter claimed to be outstanding feature.

S G Frantz Co, 161 Grand St, New York, N. Y.

Return Idler

"RUBBERDISC" return idler said to be ideal for use on any conveyor belt which handles abrasive, corrosive, damp, or sticky materials. Constructed of steel tube shaft on which are mounted series of resilient rubber disks, spaced about 6-in. apart, except at the ends, where last two are about 3-in. apart. Within steel tube are "lubricated-for-life" bearings, needing no greasing or oiling, and sealed against entrance of grit or moisture. Idler is self-cleaning, and slight deflection of disks provides belt-cleaner. Abrasion of both belt and idler said to be reduced because of non-slippage, and because of less wear in rubber-to-rubber contact. Idler turns easily, facilitating smooth starting and stopping of conveyor.



Robins Conveying Belt Co, 15 Park Row, New York, N. Y.

Portable Fire Extinguisher

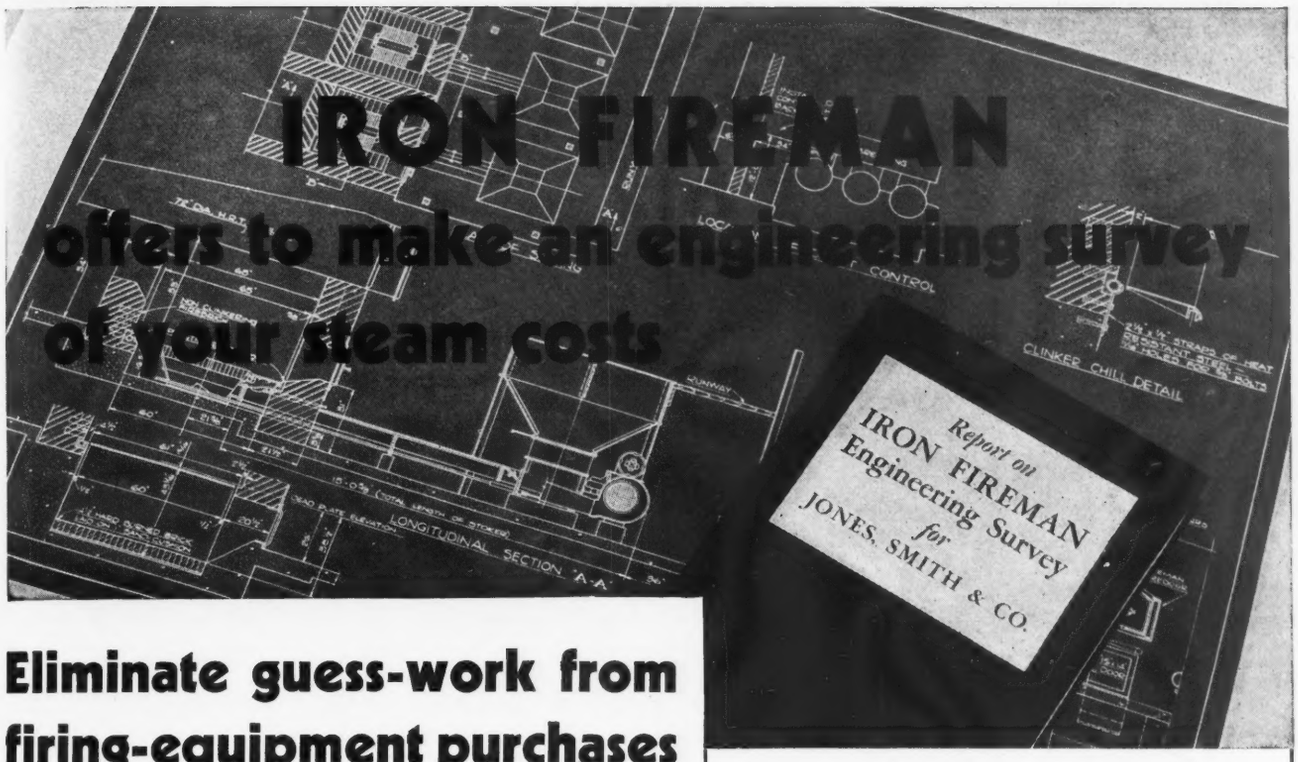
KIDDE-LUX portable 2-lb carbon-dioxide fire extinguisher features pistol-grip handle and trigger-control valve. Discharge horn is self-locking in any one position according to direction of fire. Can be operated with one hand with finger-tip control, said to make for easy and efficient discharge of carbon dioxide onto fire.

Walter Kidde & Co, 140 Cedar St, New York, N. Y.

Perforate Rubber

"MULTIPORE" consists of latex rubber with from 1100 to 6400 holes per sq in., in it formed by expansion of air through film of liquid rubber latex. Available in two types, "plain" vulcanized immediately after holes are formed, and "expanded", which is stretched or expanded before

(Continued on page 140)



Eliminate guess-work from firing-equipment purchases

Let's sit down at a table—you on one side and Iron Fireman on the other—and *look at the arithmetic* on your boiler operation. We will lay before you an engineering report on your steam costs. This report will contain full facts and figures on what Iron Fireman firing can accomplish in your boiler room. Taking into consideration your steam load, load cycle, local fuel situation, etc. . . . this Iron Fireman engineering report will give you a conservative estimate of your fuel costs with Iron Fireman firing compared with your present costs. The report will estimate your potential savings in firing room labor; estimate the various betterments and advantages you may expect, and include a rock-bottom quotation on an Iron Fireman installation.

We offer to make this report at our expense. *We will make it in cooperation with your own consulting engineer or engineer.* To obtain this report, mail the coupon below.

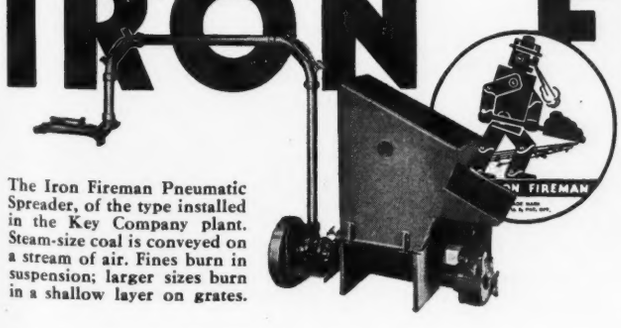
The Iron Fireman survey paid us $1177 the first year! *reports the Key Company, East St. Louis*

The Key Company, manufacturers of refinery and power plant equipment, accepted our offer to make an engineering survey of its steam costs. Two years ago the Key Company purchased an Iron Fireman Pneumatic Spreader Stoker. In the 1937-38 season, fuel costs tumbled, not just the 40% we indicated, but *a full* 48%! Dollar savings with Iron Fireman firing amounted to $1177. Says M. E. Burkhart, chief engineer of the Key Company, "The Iron Fireman installation was one of the best investments we ever made."

In the foreground, is the office building of the Key Company. At right, and behind the office building, is the factory.

IRON FIREMAN

AUTOMATIC COAL STOKERS



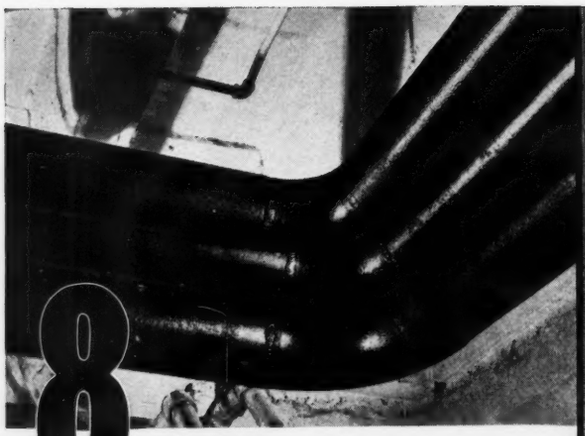
The Iron Fireman Pneumatic Spreader, of the type installed in the Key Company plant. Steam-size coal is conveyed on a stream of air. Fines burn in suspension; larger sizes burn in a shallow layer on grates.

IRON FIREMAN MFG. CO., Portland, Ore.; Cleveland; Toronto
Mail to 3172 W. 106th Street, Cleveland, Ohio. Type of plant

☐ Make survey of our steam costs ☐ Power
☐ Send catalog ☐ Commercial heating

Name_____

Address_____



8 features that mean *Better* Pipe Welding at *Lower Cost*

THREE factors determine the cost and value of every welding operation: The time it takes to prepare for welding; the time it takes to perform the welding; the soundness of the job when it is finished.

Thanks to the unduplicated combination of features illustrated here, these factors are best fulfilled by Taylor WeldELLS and other Taylor Forge Welding Fittings.

Less time is required to "get under way" when WeldELLS are used because complete marking of name, size, and weight is now rolled into every Taylor Forge Fitting. There is no hunting for fittings; no "sizing up"; no guessing; no mistakes.

Less time is required to do the job because the ends of all Taylor Forge Fittings are now clearly marked at 90° intervals to facilitate lining up. Moreover the accuracy of the fittings, the ample tangents and the clean, accurate machine-tool bevels assure a faster job and a better weld.

The finished job is better because it is made with a seamless fitting of engineered design in which wall thicknesses are never skimped and the crotch is reinforced to compensate for the greater strains that occur in this region.

It will pay you to study these features. They cut costs at every step. They make welding—the best method of pipe joining —*still better!*

ASK FOR LATEST BULLETINS

TAYLOR FORGE & PIPE WORKS

General Offices and Works:
P. O. Box 485, Chicago New York Office: 50 Church St.

TAYLOR FORGE

***WeldELLS**

Seamless Pipe Fittings for Welding

★ Trade Mark Registered

INSIST ON THESE ESSENTIAL FEATURES

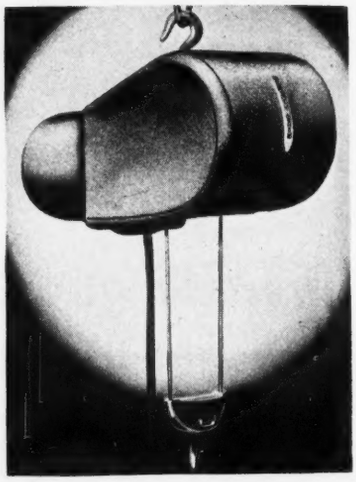
1 SEAMLESS
2 UNIFORMLY FULL PIPE THICKNESS
3 SELECTIVE, UNIFORM REINFORCEMENT
4 TANGENTS
5 MACHINE TOOL BEVELLED
6 ENDS MARKED IN QUARTERS
7 COMPLETE IDENTIFYING MARKS ON EVERY FITTING
8 A FULL LINE

vulcanization. Current applications include paste-retaining envelope for storage batteries, and miscellaneous industrial uses.

U S Rubber Co, Mechanical Div, 1790 Broadway, New York, N. Y.

Electric Hoist

"TORPEDO" hoist can be used on hook, lug, or trolley suspension, is fully enclosed and has standard pushbutton control. Comes equipped with double cast-iron drums, with right- and left-hand machined



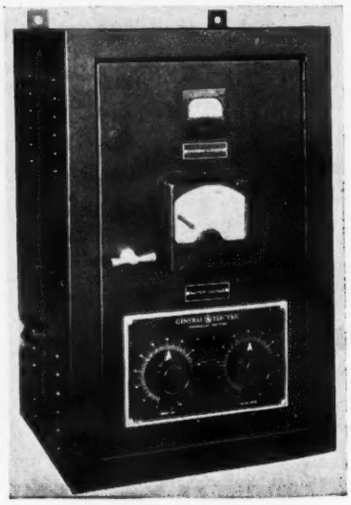
grooves, and full lift obtained with overlap of cable on drums. Two sets of gears used, one worm-gear reduction and one spur-gear reduction, both operating on ball bearings in oil bath. Available in capacities from 250 to 1000 lb.

Conco Engrg Wks, Mendota, Ill.

Battery Charger

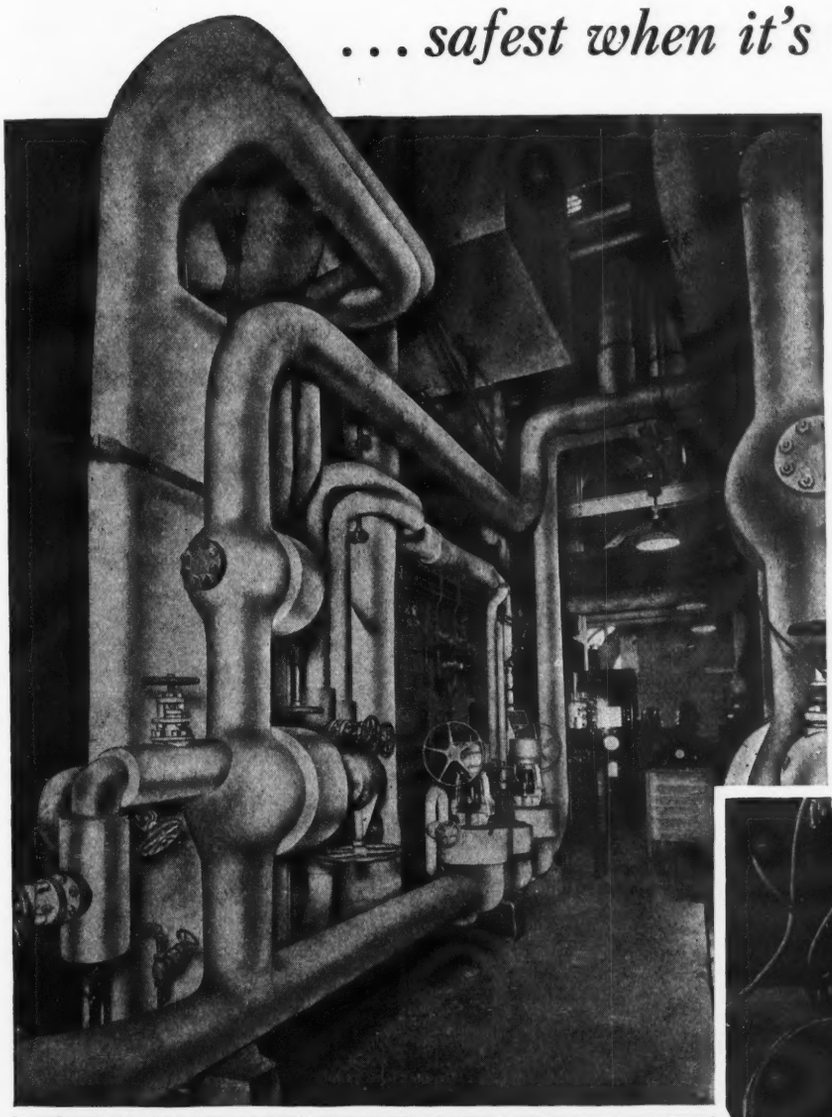
"PHANO-CHARGER" is automatic and self-regulating electronic rectifier, uses industrial-type metal phanotron rectifier tubes, and is available in 3 sizes: 4.5- and 12.5-amp to operate from single-phase power supply, and 25-amp to operate from 3-phase ac supply. Charger is adjustable and has flat voltage characteristics.

General Electric Co, Schenectady, N. Y.



Pipe under Pressure!

... *safest when it's* NATIONAL SEAMLESS



THE steam pipe that's *too safe* has never yet been made. For high-pressure steam lines are so vital to the successful operation of your plant—so much depends on their integrity—that the slightest unnecessary risk can never be justified.

That's why so many power plant operators today entrust their high-pressure steam to the power pipe that is the closest approach to the perfect tube—NATIONAL Seamless.

Here is power piping at its best. No weld along its walls to threaten safety. Nothing but solid, perfectly formed, highest-quality steel. Tough, strong walls, of uniform strength, that you can depend on for years of trouble-free service.

NATIONAL Seamless Pipe is the most widely used and most generally accepted pipe in the power industry. It is made to the A.S.T.M. specifications for plain carbon and alloy steel pipe. Write today for Bulletin No. 10.

THE BIRTHPLACE OF "WALLS WITHOUT WELDS"

This is the piercing mill, where billets of white-hot steel become NATIONAL Seamless Pipe. Only highest quality, flawless steel can endure the rolling and forging over the piercing mandrel. Any point of weakness is certain to reveal itself. You can depend on pipe that emerges from this piercing process.

NATIONAL TUBE COMPANY

PITTSBURGH, PA.

Columbia Steel Company, San Francisco, *Pacific Coast Distributors* · United States Steel Products Company, New York, *Export Distributors*

UNITED STATES STEEL

COMFORT-SUMMER & WINTER

MODERN OFFICE AND FACTORY BUILDING with Complete Air Conditioning System

Kraft-Phenix Cheese Corporation Building, Chicago, Ill. Mundie, Jensen, Bourke & Havens, architects. At left—Johnson Summer-Winter Thermostat and Humidostat controls temperature and humidity all year 'round, for each air conditioned zone.

TEMPERATURE AND HUMIDITY CONTROLLED BY JOHNSON

COMFORT AND ECONOMY—Air conditioned comfort in factories and offices produces great economies. Economy of energy, protection of materials and machinery, savings in fuel and power. But, air conditioning is only as efficient as the automatic temperature control system which provides an important part of the "operating brain-work." *Johnson* is a recognized pioneer in the modern development of automatic temperature control systems that spell maximum economy and highest possible efficiency in air conditioned buildings . . . Consult *Johnson* engineers on any automatic temperature control problem, applied to every type of heating, cooling, ventilating, and air conditioning system.

ALSO: JOHNSON CONTROL FOR INDUSTRIAL PROCESSES

JOHNSON

AUTOMATIC TEMPERATURE AND AIR CONDITIONING CONTROL

JOHNSON SERVICE COMPANY, MILWAUKEE, WIS. AND PRINCIPAL CITIES

Power Lines

(Continued from page 116)

Angeles; Colby Equipment Co, Indianapolis, Ind.; Louis P Haven, Kansas City, Mo.; J H and E C Roseberry, Buffalo; Coblentz Equipment Co, Erie, Pa.; Allan T Shepherd Co, Richmond, Va.; and George F Gilfrin, Apartardo 63 Bis, Mexico, D. F.

PROVIDENCE ENGRG SOCIETY announces election of officers for 1939. Harold P Arnold, manager of Providence office, Westinghouse Electric & Mfg Co, president; Evert W Freeman, plant engineer, Brown & Sharpe Mfg Co, vice-president; Prof W R Benford, Brown University, secretary, and Raymond H Lord, Manufacturers Mutual Fire Insurance Co, treasurer.

DEARBORN CHEMICAL Co, Chicago, announces that Daniel Delaney Powers, grandson of Dan Delaney, former manager of Dearborn Chemical Co, Cincinnati, will represent the company in Cincinnati. His offices will be in the Union Central Building.

THE DECHEMA, German Chemical Engrg Society, has moved its offices from Berlin to Franfort a.M., Dechema-Haus, Bismarckallee 25. A branch office will remain in Berlin, Haus des Vereins Deutscher Chemiker, Potsdamer Str. 111, Berlin W 35.

D J MURRAY MFG Co, Wausau, Wis., announces appointment of L & T Engrg Corp, Kansas City, Mo., as representatives in that territory, and the Ray Heat & Power Co, Chicago, Ill., to represent the Murray products in Illinois. Also, R C Kratz, Perry Bldg, Philadelphia, Pa., will represent the company in that territory.

HEWITT RUBBER CORP, Buffalo, N. Y., has expanded its Dallas, Texas, warehouse facilities. An increase in 2500 sq ft of space brings total space now in service to 7500 sq ft.

GREGORY ELECTRIC Co has moved from 1601 S Wolcott St, Chicago, Ill., to a new location at 2630-32 South Wabash Ave, Chicago, Ill.

RESISTOFLEX CORP has removed its Dover, N. J., plant and its executive offices, formerly in New York City, to Belleville, N. J., where the completed first unit of the new plant is situated. Two additional factory units are to be erected at the Belleville plant to take care of additional expansion needs.

OKONITE Co, Passaic, N. J., has established additional district office in the National Bldg, 1404 East 9th St, Cleveland, Ohio. F J Dahleiden will be in charge of this office.

NATIONAL ALUMINATE CORP, Chicago, Ill., announces transfer of R S Wise from Chicago area to south central states with headquarters at Knoxville, Tenn. T. G. Cocks, formerly at Knoxville, has moved to Chicago, and R P Clausen has been

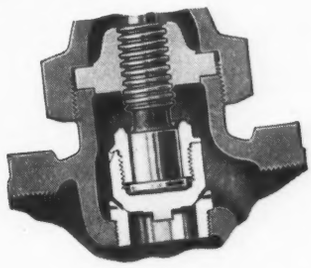
LUNKENHEIMER

STEEL GLOBE VALVES

With

Bonnet-Thread-Bushing

600 lb. SP-750° F.



1 inch
Fig. 1720
Full-Way
Type

A distinctive design with a nickel alloy bonnet-thread-bushing and stainless steel stem, seat and disc. Bushing is a separate part, highly resistive to wear at extreme temperatures with resultant longer service life.

Disc and seat ring are heat treated to provide great hardness and ground to form a pressure tight seat.

Bonnet-thread-bushing design is available in Screwed and Bolted Bonnet types; full-way or throttling; screwed or flanged.

ESTABLISHED 1862
THE LUNKENHEIMER CO.
"QUALITY"
CINCINNATI, OHIO, U.S.A.
NEW YORK CHICAGO
BOSTON PHILADELPHIA
EXPORT DEPT. 318-322 HUDSON ST., NEW YORK

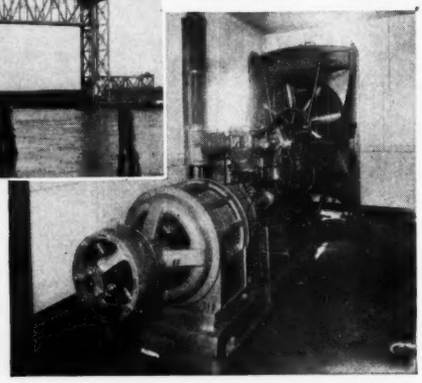
If you have no copy of List Price Schedule R1 giving new list prices of Lunkenheimer Products, ask your local Lunkenheimer distributor or write The Lunkenheimer Co., Cincinnati, Ohio.

15-72B-42

THE GOLDEN GATE BRIDGE—SAN FRANCISCO
TRIBOROUGH BRIDGE—NEW YORK
WELLAND CANAL BRIDGES—20—CANADA

The Pennsylvania Railroad Bridges, C.R.R. of N.J. Bridge, the D.L. & W. R.R. Bridges at Newark, the New York State Bridges at Albany, most all of the prominent bridges in the past 20 years have Sterling Engines, either for primary power or emergency.

STERLING HIGH DUTY INTERNAL COMBUSTION ENGINES



Cape Cod Canal Bridge at Buzzards Bay, Massachusetts, project of U. S. Engineers, is equipped with 125 K.W. 1200 R.P.M. generator, driven by Sterling Dolphin C 8-cylinder gasoline engine.

The accumulated data, covering all details required for a successful installation — yours on request.

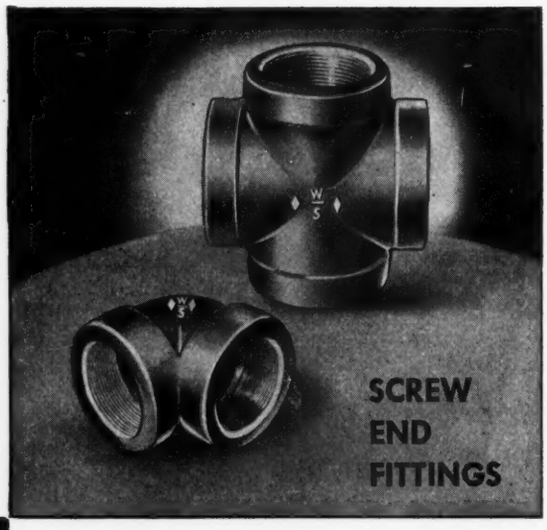
STERLING ENGINE COMPANY

Home Office and Plant, 1270 NIAGARA STREET, BUFFALO, NEW YORK

Dept. C-1

Branch Office, 900 CHRYSLER BLDG., NEW YORK, N. Y.

W-S FORGED STEEL FITTINGS *for* **HIGH TEMPERATURE HIGH PRESSURE SERVICE**



Wherever pipe lines carry steam, water, oil, gas or ammonia—under high pressures and temperatures —you can depend on W-S Forged Steel Fittings for safety, long life and low maintenance.

W-S Fittings are bored from solid forgings with openings equal in area to the bore of the pipe, thus assuring free flow. Walls are of uniform thickness and because of the forging process are of dense structure, free from defects.

W-S Fittings are available in Welding and Screw End Types in a wide range of sizes. The Watson-Stillman Co., Roselle, N. J.

WATSON W-S STILLMAN

appointed Junior engineer in the Philadelphia territory.

WORTHINGTON PUMP & MACHINERY CORP, Harrison, N. J., announces election of Clarence E Searle, of Bronxville, N. Y., and Hobart C Ramsey, of Short Hills, N. J., to the board of directors.

BRIGGS & STRATTON CORP, Milwaukee, Wis., has become exclusive licensees for the manufacture and sale of the Graham variable speed unit, formerly built by Graham Transmissions, Inc. L A Graham and A Madle, formerly vice-president and chief engineer, have joined the Briggs & Stratton organization.

INDUSTRIAL BROWNHOIST CORP, Cleveland, Ohio, announces the election of Melvin Pattison to chairman of the board of directors, and Hoyt E Hayes, president and treasurer.

WARD LEONARD ELECTRIC CO, Mt Vernon, N. Y., announces appointment of C B Rogers as representative for the sale of Ward Leonard Electric Control Devices. Mr Rogers' territory will be in the states of Georgia, North and South Carolina.

CHICAGO PULLEY & SHAFTING CO, Chicago, Ill., has been appointed distributor of Ajax flexible couplings.

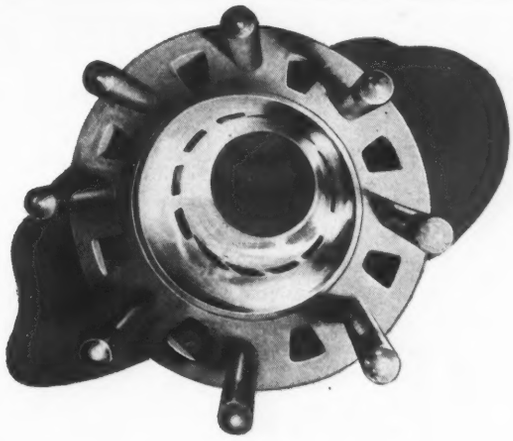
PHILADELPHIA GEAR WORKS will open new branch office in Chicago. Address will be 111 W Washington St, and A R Robert will be district manager. R C Jones has been chosen representative in the lower New England territory with headquarters in Hartford, Conn. Post Office address will be Box 1421.

OBITUARIES

WILLIAM H KAVANAUGH, 65, professor of experimental engineering at the University of Pennsylvania, and formerly of the University of Minnesota, died recently in Philadelphia, Pa. He had been ill only a short time. Following Professor Kavanaugh's graduation from Lehigh University in 1894, he became an instructor in mechanical engineering at the University of Minnesota, later being appointed professor of experimental engineering. In 1916 he left Minnesota to accept a position at the University of Pennsylvania, which he held at the time of his death.

GEORGE CARTER MILLER, 64, president of Dodge Mfg Corp, Mishawaka, Ind., died suddenly May 10, after a 10-day illness. He was born in Cincinnati, Ohio, in 1875, and was educated in the Cincinnati Institute of Technology and the University of Cincinnati. Mr. Miller was active in the United States Chamber of Commerce and the Power Transmission Council. He was at one time superintendent of Charles Williams Stores, New York; general manager of Montgomery Ward & Co; general manager, Beaver Products Co, President Tillotson Mfg Co; and vice-president, George W. Goethals Co, N. Y. He became president of Dodge Mfg Corp in March, 1923.

WILLIAM C STEVENS, 55, vice-president in charge of engineering, secretary and director of Cutler-Hammer, Inc, died re-



What about CYLINDER GLAZE

and Surface Treatment of piston rings

CYLINDER glaze is the work-hardened skin that develops on cast iron which lowers its co-efficient of friction and provides great resistance to wear. The ability of cast iron to develop such a skin is peculiar to the material and constitutes one of its chief advantages. No matter how highly finished a new cylinder may be, much material is removed during initial operation in the process of converting the conventional finish to a natural wear resisting skin. If the glaze is damaged or destroyed, the cycle must be repeated at further cost of cylinder life.

In a new engine, wear resisting skins are developed simultaneously on both cylinder and piston rings. But when replacement rings are installed, the cylinder glaze already established, is exposed to the machine finish of the new rings which, in passing through the stage of work-hardening, impairs, and in extreme cases, destroys the cylinder glaze.

Now for the first time you may obtain rings having preconditioned wearing surfaces . . . COOK'S TINIZED Rings. These are standard COOK'S GRAPHITIC IRON rings coated with a non-scuff anti-friction metal which prevents cast iron to cast iron friction during the break-in period. As this anti-friction metal wears away, the ring surface is work-hardened in such a gradual fashion that the cylinder skin remains undamaged.

For reduced cylinder wear and fewer ring replacements install COOK'S TINIZED Rings. They fit existing grooves and the cost is only slightly more than standard rings. Specify COOK'S Rings with Tinized surface treatment on your next order.

And when you order, take advantage of COOK'S experience in serving the builders and operators of industrial size engines for over 50 years. Ask us to recommend the proper ring set-up for your particular engine. Informative literature gladly sent to interested parties.

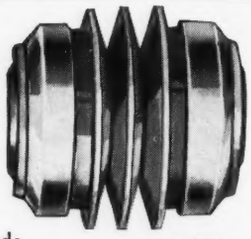
C. LEE COOK MANUFACTURING CO.
INCORPORATED
LOUISVILLE, KY.

New York · Cleveland · Los Angeles · Baltimore · Chicago · Tulsa · New Orleans · San Francisco

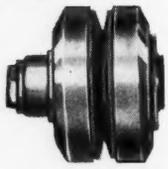
COOK'S TINIZED GRAPHITIC IRON Piston Rings
"Sealing Pressures" Since 1888

HOW TO GET INFINITE *Variable* SPEED
with constant speed motors and Standard V-Belts—AT LOW COST

It won't cost you much to install this modern pulley on machines in service or incorporate it in new machines and you will, as users say, get "highly satisfactory results."



HI-LO AUTOMATIC PULLEY



gives you a pulley made by specialists to meet your particular need. You get a thousand speeds — this specially developed type is available in a variety of sizes and types to be adequate for all services—you can handle drives from fractional up to 5 H.P.

Dependable at all times in service

They maintain constant speed at any set point no matter how the load varies, and automatically regulate belt tension to the load. At no time is the tension greater than that actually required to carry the load.

Write for bulletin giving engineering data and prices which are low. Installation pictures are also shown.

EQUIPMENT ENGINEERING CO.
2853 COLUMBUS AVE. MINNEAPOLIS, MINN.

F&E *Hydraulic Powered*
UNDERFEED
STOKERS

This exclusive Five-Feature Combination assures dependability, efficiency and fuel economy.

1. Unit Type Electro-Hydraulic Drive
2. Interval Timer Governor (patented)
3. Sliding Bottom Retort
4. Fuel Bed Regulator
5. High Efficiency Tuyeres

F&E
Flynn & Emrich Co.
ESTABLISHED 1842 BALTIMORE, MD.

cently. He had been with the company since 1906. He studied in Cornell University and was graduated in 1906, after which he joined the Cutler-Hammer Engineering Dept in Milwaukee, Wis. From 1910 to 1912 he was associated with the Sales Department at Milwaukee, and in 1913 became district manager of the Western Div out of Chicago. The following year he was made Eastern District Manager with offices in New York City. Mr Stevens returned to Milwaukee in 1917, where he was General Sales Manager, a position he held until 1924, when he headed the Development Dept. He held the latter position for 6 years, and was then appointed to the executive position he held at the time of his death. He had a fellowship with the American Institute of Electrical Engineers, and since 1930 was a director of Globe Union, Inc, Milwaukee, Wis.

RICHARD A JENNINGS, 43, chief engineer of Keith's Memorial Theatre, Boston, Mass., died in Boston on May 7. He was born in Brooklyn, N. Y., and has been with Keith's for about 27 years.

S C FOSTER, chief engineer, Hydroelectric Co of Va, Bedford Pulp & Paper Co; and vice-president, Bank of Big Island, died recently in University Hospital, Charlottesville, Va. He was stricken with heart attack.

WILLIAM F JENKINS, 71, engineer at Manhattan Market, Cambridge, Mass., died at his home there on May 29. He was a native of St. John, N. B. For many years he operated steam plants in New Hampshire and Florida hotels.

WALTER C FLAVIN, 60, manager of New England office of Sloan Valve Co, Chicago, died May 16 at his home in Arlington, Mass., from a heart attack.

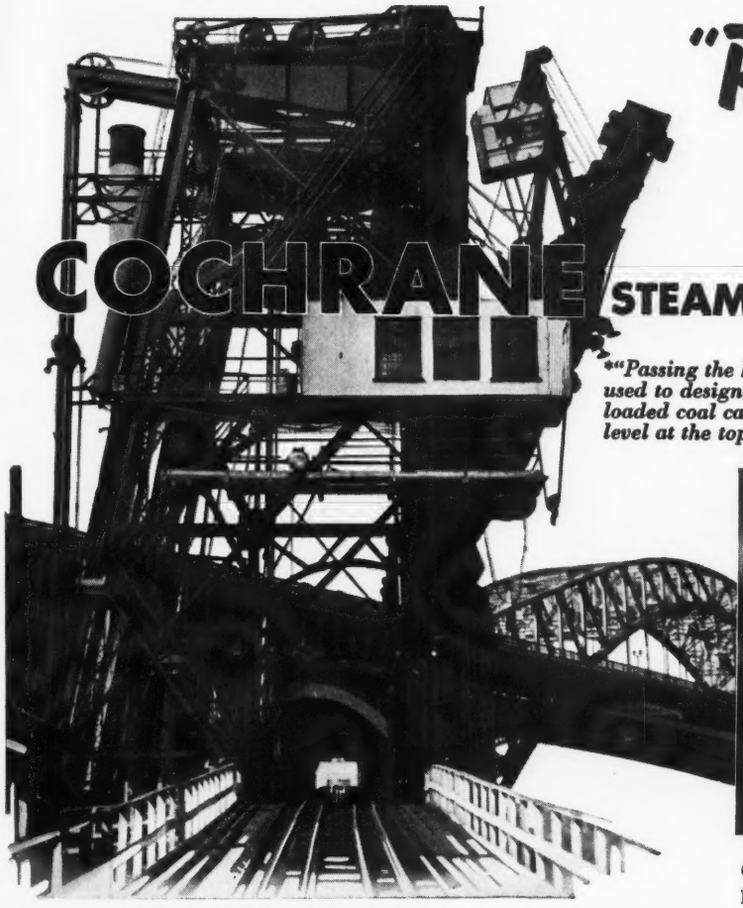
GEORGE LEBEL, 60, formerly assistant engineer at the Somersworth, N. H., pumping station, died at his home there on May 4 after a short illness. He was a member of the city council and the finance committee of Somersworth.

RICHARD E MAXWELL, 72, engineer at Bristol County Court House, Taunton, Mass., died on May 2 at his home in that city.

PERSONALS

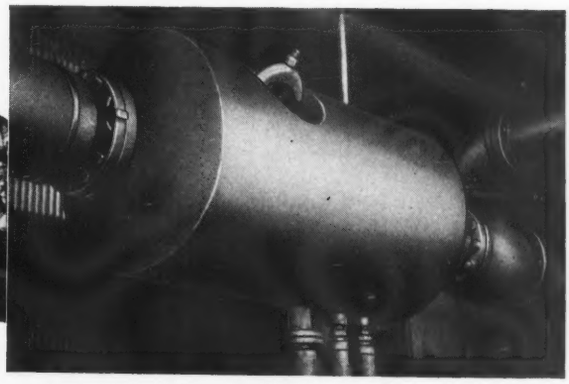
H Y BASSETT, graduate engineer, has joined the staff of the Wolverine Tube Co, Detroit, Mich., as research engineer. A long experience in the copper and zinc mines of Mexico formed his background before he entered the employ of the Chase Brass & Co. In 1930 he was assistant metallurgist at the company's new mill in Cleveland, holding that position seven years. Mr Bassett left the Chase organization in 1937 to work for the Surface Combustion Corp, Toledo. In his new position, Mr. Bassett will be in charge of research problems arising from market developments.

WALTER GEIST, general representative of Allis-Chalmers Mfg Co, has been elected a vice-president. Mr Geist entered the service of Allis-Chalmers in 1909 as errand boy in the Saw Mill Engrg Dept. From



"Pass the hump"* with COCHRANE STEAM PURIFIERS

*"Passing the hump" is an expression used to designate the point at which loaded coal cars attain the dumping level at the top of the grade.



Cochrane Steam Purifier installed on stationary power plant developing electricity at Pittsburgh Coal Co., Cleveland, Ohio

"PASSING the hump" is a term which may well be associated with Cochrane Steam Purifiers. When large demands for steam induce the carry-over of water slugs from boiler to engine or turbine, the use of a Cochrane Purifier is positive assurance of removing the entrained moisture, water slugs, and solids, thereby protecting the prime movers and permitting maintenance of high efficiencies.

Take, for example, the experience of the Pittsburgh Coal Co. at Cleveland, Ohio. Here coal is transferred from rail to river barge in the loading station shown above and the steam demand varies, within a few minutes, from idling load to full capacity. In generating power to pull loaded cars up the grade to the dumping level of the station, the sudden requirement for increased steam formerly caused water slugs to be thrown into the engine cylinders. This reduced the engine power, wiped oil from valves and cylinders and, aside from causing enormous maintenance costs, made it impossible to pull the loaded cars over the hump without serious delays.

The installation of a Cochrane Steam Purifier corrected this situation. Now the cars "pass the hump" without difficulty. The Purifier protects the engine from water slugs, insures ample engine power during the period of greatest demand, and within the course of the past nine years of service has confined the cost of engine maintenance to a minimum.

Even as important to officials of the Pittsburgh Coal Co. is the fact that the use of the Cochrane Purifier enabled them to improve upon the service rendered their customers by removing the delays suffered in "passing the hump" at their barge loading station.

If you are interested in the elimination of carry-over in boiler operation, write for a copy of Publication No. 2725.

COCHRANE CORPORATION • 3106 N. 17th St., Philadelphia, Pa.

COCHRANE

WATER SOFTENERS • DEAERATING HEATERS • FILTERS • BLOW-DOWN EQUIPMENT • VALVES • FLOW METERS

YARWAY
INVOLUTE
SPRAY
NOZZLES

Unique Yarway Involute design.

No internal parts or vanes to clog or erode.

Unobstructed flow gives minimum loss of head.

Finely divided spray cone provides rapid cooling.

Renewable orifices adapt nozzles for any service.

Installations total more than 5 million gallons per minute in water cooling and air conditioning service.

Made in both cast and bar-stock types. All sizes from ¼ in. to 2½ in. Write for Catalog N-615.

YARNALL-WARING COMPANY
100 Mermaid Ave. Philadelphia

that position he advanced to draftsman and other various positions until he was made assistant manager of the Milling Dept on July 1, 1928. He was responsible for the multiple V-belt drive principle of power transmission, known as the Texrope drive. He was appointed general representative in 1933, in which capacity he supervised the personnel of all district offices.

WILLARD H COBB, formerly general factory manager, Mechanical Goods Plant, United States Rubber Co, has been appointed general manager of the Mechanical Goods and General Products Div. Herbert E Smith, vice-president, will continue to supervise activities of all divisions. Mr. Cobb is a graduate of Stevens Institute of Technology, and joined the company in 1914.

R E S GEARE has been appointed general sales manager of T B Wood's Sons Co, Chamberburg, Pa. He was formerly vice-president in charge of sales and engineering of the L H Gilmer Co, Philadelphia.

EDWARD A MEAD, previously assistant sales manager, has been made sales manager of the Nash Engrg Co, South Norwalk, Conn. He joined the company 14 years ago and for the past 10 years held the position of assistant sales manager.

B F PICKARD, for the past 5 years president of the Central States Power & Light Corp, was elected president of the Interstate Power Co recently. Both Central States Power & Light Corp, and Interstate Power Co, are subsidiaries of the Utilities Power & Light Corp of Chicago. Mr Pickard will have his office in Dubuque, Iowa, headquarters of the Interstate Power Co.

C H KUTHE is now technical advisor to Michigan Div, Revere Copper & Brass, Inc. He is an alumnus of Case School of Applied Science, Cleveland, Ohio, being graduated in 1932 and securing his master's degree in 1937. After graduation he became associated with Steel & Tubes Div, Timken Roller Bearing Co. Mr Kuthe was acting in sales engineering capacity for that company until two years prior to his appointment at Revere Copper & Brass, Inc.

EUGENE F BOHACH has been appointed middle western representative of Greene, Tweed & Co, New York, N. Y., to replace V B Nickerson, resigned. Mr Bohach will have his offices at 163 E Walton Place, Chicago, Ill.

EDWIN J SCHWANHAUSSER, former works manager, has been elected a vice-president of Worthington Pump & Machinery Co, Harrison, N. J. He joined the company in 1915, following his graduation from Stevens Institute of Technology, and was assigned to the Harrison, N. J., Works. He reached the position of assistant works manager in 1927, and in 1929 was transferred to Buffalo, N. Y., Works, as works manager, the position he held at the time of his election as vice-president.

S R WESTON, chief engineer in charge of New Brunswick Power Commission, has been engaged in a consultant capacity by British Columbia Utilities Commission.

Take off the INVISIBLE Brakes—

The unseen forces that:
—REDUCE POWER
—RETARD SPEED
—INCREASE COST
—CHEAT PRODUCTION
—WEAR OUT MACHINERY

DIXON'S GRAPHITED LUBRICANTS successfully fight friction, check machinery wear, increase power—which means *higher plant efficiency.*

DIXON'S TICONDEROGA
FLAKE LUBRICATING GRAPHITE

meets the exacting lubrication requirements of present-day fast-speed power and production equipment all over the world.

For fifty years power engineers have recognized the inherent qualities of this Dixon product—and they rate it higher today than ever before as an indispensable lubricant, an invaluable coating for gaskets, for packing and miscellaneous uses, with modern fast-production machinery.

Dixon's Ticonderoga Flake Lubricating Graphite comes in two Flake sizes:

No. 1—Large unctuous, lustrous flakes of highest grade.

No. 2—Finely, sub-divided, powdered flakes of highest grade.

DIXON'S MICROFYNE FLAKE GRAPHITE

Processed to a microscopic subdivision in particle size. Offers oilless, greaseless, temperature-proof, combustion-proof, water-proof lubrication. When used as a co-lubricant with oil or grease, it often gives more than double the service. Can be cleanly and economically applied with a Dixon's Rubber Graph-Air Gun.

Available in cans, buckets and drums.

Write Dept. C-44 for booklet: "Dixon's Graphite Productions For General Industrial Uses."

HANDLED BY ALL DEALERS

JOSEPH DIXON CRUCIBLE CO.

Jersey City, New Jersey

DIXON'S GRAPHITE PRODUCTIONS

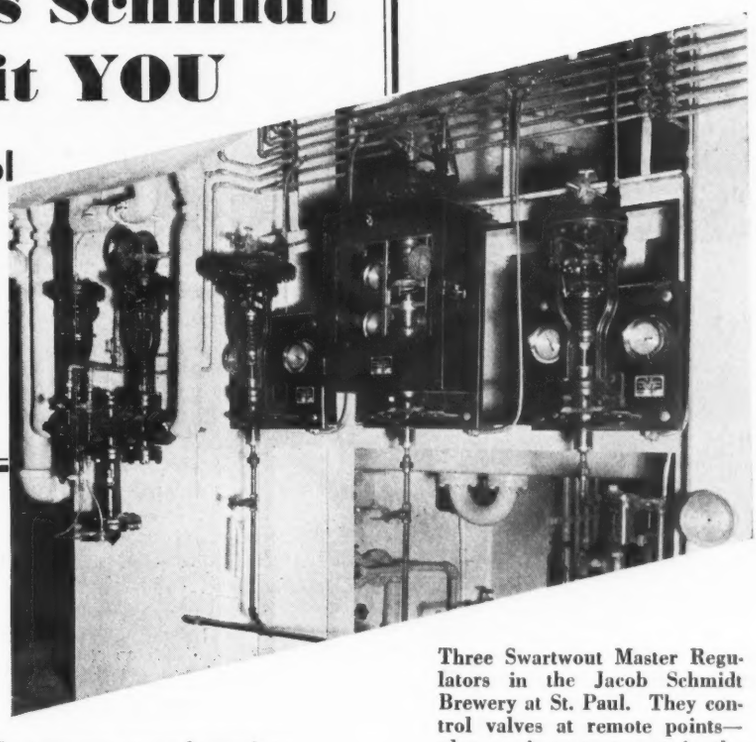
SEND FOR CIRCULARS

What Profits Schmidt Can Profit YOU

Gain unfailing power control with

Swartwout

Master Regulators and other control equipment



Three Swartwout Master Regulators in the Jacob Schmidt Brewery at St. Paul. They control valves at remote points—play an important part in the manufacture of the nationally known Schmidt product.

If it's your job to supply power for a process as particular and intricate as brewing, you can appreciate the hard cash value *of perfect control delivered by Swartwout Equipment.*

You should know that every step of Swartwout manufacturing—from drawing board to final adjustment—embodies specialized knowledge and skill, use of sturdiest materials, expert craftsmanship, and proved principles—including the famous Swartwout "S-C" design in controls and valves.

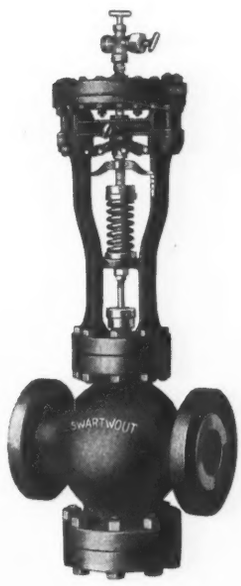
Because even a short delay in brewing may be costly, Jacob Schmidt Brewing Company made it their business to know all this when they selected, on the basis of *quality and worry-free operating capacity*, the following Swartwout Products:

Eleven Pressure Reducing Valves
Six Swartwout Master Controllers
Four Feed Water Regulators Two Pump Governors
Two Complete Reducing and Desuperheating Stations
Six Steam or Oil Separators
Fifty-Six Traps Two Exhaust Heads

This equipment has operated almost continuously 24 hours daily since 1934, with no break-downs and very few renewals of minor parts. You can have the same profitable power control that profits this famous brewery.

It's worth while knowing you can lick your worst worries—have a model power plant set-up. Ask Swartwout engineers to help check your needs. Write today for information—describe your problems.

THE SWARTWOUT COMPANY
18501 EUCLID AVE. CLEVELAND, OHIO



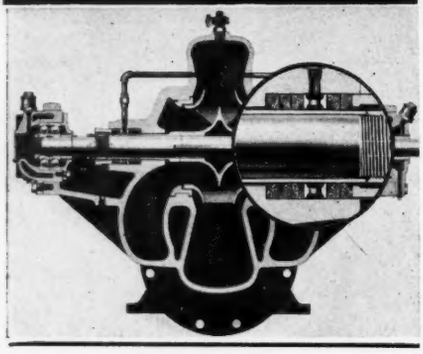
Swartwout Valves are adapted to a wide variety of uses for controlling the flow of gases and liquids. Thirty-five years experience in building this equipment assures you completely satisfactory performance.

Feed Water Regulators • Pump Governors • Feed Water Heaters
Master Controls • Reducing Valves • Separators • Exhaust Heads

Swartwout

•Power Plant Equipment•

For Centrifugal Pumps — Sea-Ro Nek-Seal Packing!*



Sea-Ro Nek-Seal No. 501-C. Installed in Worthington Type LA Centrifugal Pump.

● Sea-Ro Nek-Seal Packing Rings No. 501-C are specifically designed for Centrifugal and Rotary Pump service. They eliminate packing trouble at its source—in stuffing box clearance spaces.

● Because of its patented construction, Nek-Seal cannot crowd through the gland. High speeds and high temperatures will not affect its sealing ability. Nek-Seal gives you *permanent* sealing without friction.

● Unlike ordinary packing, Nek-Seal does not vulcanize or carbonize in the stuffing box. This means long life for both pump and packing because scoring and pitting of the shaft are eliminated.

● Check up on Sea-Ro No. 501-C —Investigate its possibilities for your own high pressure Centrifugal and Rotary equipment. You may find it to be the answer to your packing problem.

*Reg. U. S. Pat. Off.

Sea-Ro Packing Company
75 West Street, New York, N.Y.

SEA-RO

Mr. Weston will investigate the British Columbia hydro-electric setup with special regard to appraisals and extensions.

W Robert Timken, who has been with the Timken Roller Bearing Co since 1933, was appointed assistant to the president. He will maintain his offices at the company's general office in Canton, Ohio. He is a graduate of Harvard University, and has been employed at various positions throughout the plant.

J G Pollock, formerly superintendent of electrical and mechanical equipment of the Jamison Coal & Coke Co, Greensburg, Pa., is now connected with the Wallace E Kirk Co, Pittsburgh, Pa., as associate engineer.

Guy W Thaxton, recently appointed chief engineer of the Rural Electrification Administration, has served the Southern Bell Telephone Co, the Tennessee Coal, Iron and Railroad Co, Alabama Power Co, Westinghouse Electric & Mfg Co, Mississippi Utilities Co, Mid-South Public Service Co, and the Tennessee Valley Authority. He has also seen service with army signal corps, and has been an instructor at Georgia School of Technology and Mississippi State College. He was made regional engineer of the REA in 1935, later being promoted to chief engineer. Mr Thaxton belongs to the Tau Beta Pi, Public Ownership League of America, and the American Institute of Electrical Engineering.

Dr William McClellan, president of the Potomac Electric Power Co, since 1933, has been appointed as administrator of the Union Electric Light & Power Co, of St. Louis.

Charles M Kirkland has been elected secretary of the Okonite Co, Passaic, N. J., and the Okonite Callender Cable Co, Paterson, N. J. Mr Kirkland is a graduate of Harvard University, and has worked in the company's plants and sales forces. He will have his office at 501 Fifth Ave, New York, N. Y.

S J Horrell has been appointed assistant sales manager of Power Piping Div of Blaw-Knox Co. During the past 9 years, Mr Horrell has been associated with the Grinnell Co, in the design and sale of pre-fabricated piping.

R W Eichenberger, vice-president of Robins Conveying Belt Co, formerly acting as Chicago office manager, has been transferred to the New York office of the company. He will have his office at 15 Park Row.

STRAWS

Pointing the way business winds blow

ARIZONA——Safford plans natural-gas distribution system, requiring about 160,000 lin ft of steel pipe, 1- to 8-in. dia, with larger pipe to be used for main supply line connecting with system of El Paso Natural Gas Co, El Paso, Tex., now in course of construction from Gage, N. Mex., to Globe. Will also install control station and operating facilities. Bond issue of $135,000 authorized. Plans under consideration for extensions in system for natural-gas service at Thatcher and vicinity, Gila Valley area. Cost estimated about $70,000 in addition to amount noted. Weiland Engrg Co, Pueblo, Colo., consulting engineer.

Save Air—Save Dollars

ROCKWELL BLAST GATES

Threaded Slide Type

Flanged Slide Type

For Low Pressure Air

●

Slide Type
Butterfly Type
Kwikleen Type

●

Write for catalog No. 3760

●

W. S. ROCKWELL COMPANY
50 CHURCH ST., NEW YORK

HERCULES
Seamless Copper
FLOATS

GUARANTEED TO STAND UP!

Every Hercules Float carries our guarantee to stand up under 350 lbs. working pressure and 500 degrees temperature.

Fabricated of seamless copper under our special spinning process, Hercules Floats are uniform in thickness and high in mechanical strength.

You can depend on Hercules for floats—in standard shapes up to 10 in. and in special types to your specifications—to give long, dependable, economical service.

Insure care-free maintenance of water level in your heaters, tanks, reservoirs and other equipment by specifying "HERCULES."

HERCULES FLOAT WORKS
200 Franklin St.
SPRINGFIELD, MASS.

Purchase Price of rope doesn't fool me. Don't let it fool you. Purchase Price means little to ultimate rope costs. It is the rope cost per-mile-car-travel . . . per-M-feet-of-lumber . . . per-foot-hole-drilled that tell you the real story of quality. Wickwire Ropes cost no more to buy than other recognized brands . . . but they are fabricated with a knowledge and care beyond accepted requirements. Greater flexibility, greater toughness . . . long life results. Use a Wickwire Regular Lay or a Wisscolay Preformed Rope and measure the service it gives you by your unit of use. Then you'll know you are using the finest rope.

WICKWIRE SPENCER STEEL COMPANY

General Offices: 500 Fifth Avenue, New York City; Sales Offices and Warehouses: Worcester, New York, Chicago, Buffalo, San Francisco, Los Angeles, Tulsa, Chattanooga, Houston, Abilene, Texas, Seattle. Export Sales Department: New York City.

2-TURBINE TEST VENTURIS
9 13/16 X 6-CAST STEEL
250 LBS. WORKING PRESSURE
1,160,000 LBS. PER HOUR
2-EVAP. COND. PUMPS VISC.
2.90 X 1 5/16-CAST STEEL
250 LBS. WORKING PRESSURE
50,000 LBS. PER HOUR

ACCURACY PROVEN . . .

NOT JUST CLAIMED

Before installation at the Indiana "State Line" Generating Station eleven Simplex Venturi Tubes (shown above) were subjected to every conceivable test for accuracy at the University of Pennsylvania's Hydraulic Laboratory. Measurements, characteristics, rates for coefficient velocity relationship were all determined by precision instruments and actual weighing of the flow. Construction engineers, Sargent and Lundy, acknowledged that Simplex Venturi Tubes satisfy the most demanding requirements . . . Let Simplex engineers show you How and Why you can benefit.

SIMPLEX VALVE & METER CO.

6780 UPLAND ST., PHILA., PA.

Because they measure speed simply by contact

"FRAHM" VIBRATING-REED TACHOMETERS

are the solution to a wide variety of speed-measuring problems, as well as for indicating rates of vibration. Types for permanent mounting as well as for hand use.

Write for descriptive Bulletin 1590-P.

JAMES G. BIDDLE CO. 1211-13 ARCH STREET PHILADELPHIA, PA.

CALIFORNIA—Ducommun Metals & Supply Co, 219 South Central Ave, Los Angeles, plans new plant on 6-acre tract at Alameda and 49th Sts, Vernon district, with main unit 290 x 600 ft. Complete mechanical-handling equipment will be installed. Cost about $300,000. Albert C Martin, Higgins Bldg, Los Angeles, architect.

Pasadena, C W Koiner, city manager, plans installation of mechanical blower units for aeration tank operation at municipal sewage-disposal works. Cost about $25,000. Harvey W Hincks, city engineer.

Taft Union High School District, Taft, will award contracts soon for central-heating plant at high school, to include 2 boiler units. Cost about $60,000. Franklin & Kump, Haberfelde Bldg, Bakersfield, architects.

Clarkiron Co, 20101 S Normandie Ave, Los Angeles, Earl Reynolds, president, plans power house at new iron-ore-extraction plant on site near city. Entire project will cost about $500,000.

Water and Power Commission, 205 S Broadway, Los Angeles, will award contract soon for induced-draft system at steam-electric power plant at Seal Beach.

Halfmoon Bay Drum & Box Co, Colma, plans boiler plant in connection with rebuilding of mill, recently destroyed by fire. Loss over $150,000.

Intercoast Amusement, Inc, Merced, plans air-conditioning system in new local motion picture theatre at 17th and J Sts, to be known as Gateway Theatre. Will be built this summer. Cost about $120,000. S Charles Lee, 1648 Wilshire Blvd, Los Angeles, architect.

COLORADO—Bd of Directors, Colorado State Hospital, Pueblo, has low bid at $66,877.00 from Stephan & Lambert, Pueblo, for furnishing and installing 2 boiler units in power house at institution, including superheater, stoker, and forced-draft fan, and will make award soon. Boilers will have rated capacity for generating 40,000 lb of steam per hr. Architectural Associates, Thatcher Bldg, Pueblo, architects.

Bd of Directors, Colorado State College, Fort Collins, contracted Olson-Benbow Plumbing & Heating Co, 116 N Weber St, Colorado Springs, for improvements in boiler house at institution, including additional equipment, at $58,700. Frewen & Morris, Midland Savings Bldg, Denver, architects.

Fort Collins plans improvements in municipal electric power plant, including new boiler, steam turbine-generator and auxiliary equipment. Cost about $320,000. Financing is being arranged through Federal aid.

CONNECTICUT—Socony-Vacuum Oil Co, 26 Broadway, New York, N. Y., plans new 6-in. welded-steel pipeline from Hartford to Springfield, Mass., about 25 mi, for gasoline transmission. Work will begin early in fall.

V. La Rosa & Sons, Inc, 473 Kent Ave, Brooklyn, N. Y., food-product manufacturer, has authorized 2-story plant, 85 x 400 ft, at Danielson. Cost over $100,000 with power equipment and machinery. Leo F Caproni, 1221 Chapel St, New Haven, architect.

New Britain is making surveys and estimates of cost for municipal electric plant. Louis T Klauder, Lincoln-Liberty Bldg, Philadelphia, Pa., consulting engineer.

Armstrong Rubber Co, West Haven, plans boiler house for mill service, with oil-fired boiler unit. Fletcher-Thompson, Inc, 1336 Fairfield Ave, Bridgeport, architect and engineer.

FLORIDA—Florida Public Utilities Co, Fernandina, contracted Engrg Contractors Co, Bona Allen Bldg, Atlanta, Ga., for 1-story addition to cold-storage plant on Lime St, 45 x 100 ft, to be equipped as a refrigerating unit. Cost over $50,000, with machinery.

Waldorf Building Corp, 620 Lincoln Rd, Miami Beach, plans central-heating plant in 8-story hotel at 2425 Collins Ave. Cost about $225,000. Albert Anis, 925 Lincoln Rd, architect.

GEORGIA—Atlanta Coca-Cola Bottling Co, 560 Edgewood Ave, Atlanta, has approved plans for 2-story and basement mechanical-bottling plant, 200 x 225 ft, at Spring, Williams and Sixth Sts, and will begin erection soon. Cost about $250,000 with conveyors, loaders and power equipment. George H Bond, Candler Bldg, architect.

ILLINOIS—Alexander Carr Lumber Co, Aurora, is considering new boiler house in proposed rebuilding of mill recently destroyed by fire. Loss estimated close to $100,000.

RUGGED

FIG. 102
BRONZE GLOBE
VALVE.

FIG. 375
BRONZE GATE
VALVE.

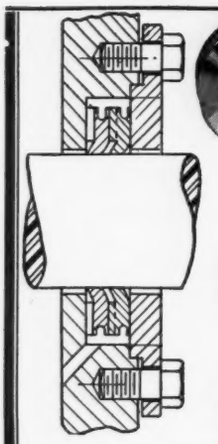
FIG. 150
BRONZE GLOBE
VALVE.

RUGGED VALVE CONSTRUCTION IS ESPECIALLY DESIRABLE TO THE ENGINEER. IT MEANS WITHSTANDING ABNORMAL WORKING CONDITIONS - - - YEARS OF SAFE, TROUBLE-FREE VALVE PERFORMANCE

Specify

POWELL VALVES

THE WM. POWELL CO. CINCINNATI, OHIO



Sold on approval
Satisfaction Guaranteed

SAVES OIL

France Oil Return wiper rings are made to conform to the design of the splash plate. Users report a considerable saving in oil from this type of installation.

Accurate and prompt service for complete sets or renewals for any type of existing splash plates. Write for catalog of commonly used types.

THE FRANCE PACKING CO.
Tacony, Phila., Penna.
Branch offices in principal cities

Original **FRANCE METAL PACKING**

They Hold

Many types of power plant equipment are subject to vibration or reciprocating motions causing nuts to shake loose on foundations and many other locations as well. These definitely need the protection of

UNSHAKO

The Nuts that can't shake loose

The built-in locking ring is always on guard, ready to spring to life and grip the nut whenever a backing-off tendency occurs. "Unshako" Nuts are one-piece construction. Can be removed with an ordinary wrench and re-used as desired.

Fig. 1513

Pat'd. and Pat's. Pend.

Send now for complete information.

STANDARD PRESSED STEEL CO.

Branches JENKINTOWN, PA. Branches
Boston — Chicago
Detroit — BOX 577 — St. Louis
Indianapolis — San Francisco

Buffalo prefers FRICK

TRADE FRICK MARK

And proves it with over 1000 installations—for air conditioning, food service, cooling drinking water, making ice, cold storage, industrial processes, and dozens of other purposes. All credited to Mollenberg-Betz Machine Co., Frick Sales Representatives. Get figures now on that cooling equipment you need, large or small, write:

FRICK COMPANY
Waynesboro, Penna.

Refrigeration

Deere & Co, Moline, manufacturer of agricultural implements, plans 3 additions to plants at Moline and East Moline, 5-story, 95 x 150 ft, 1-story, 80 x 260 ft, and 1-story, 100 x 120 ft. Cost over $500,000, with power equipment, etc. C A Eckerman, company architect.

Abbott Laboratories, 14th St and Sheridan Rd, North Chicago, plans boiler house at chemical plant, with 40,000-lb-per-hr watertube boiler, stoker, and coal- and ash-handling machinery. Battey & Childs, 231 S LaSalle St, Chicago, architects.

INDIANA——Dyer (Lake County) plans boiler house for heating service at waterworks station and other structures and will award contracts soon for boiler unit. Ray Seeley, 12 Elizabeth St, Hammond, architect.

Gary Sanitary District plans blower house for sewage station, to be 1-story, 80 x 240 ft, with 5 gas-engine units, 5 centrifugal-type blowers, 5 pumping units and complete equipment. Bids scheduled to be asked soon. Alvord, Burdick & Howson, 20 N Wacker Dr, Chicago, Ill., consulting engineers.

Delaware County Housing Authority, Muncie, H L Carr, executive secretary, plans central-heating plant at housing development on site near city. Cost about $500,000. Graham & Knowlton, Security Trust Bldg, Indianapolis, architects.

IOWA——Woodbine voters recently approved proposed municipal light and power plant estimated to cost $115,000. J Harrington, Omaha, Neb., consulting engineer.

Preston has approved bond issue of $45,000 for municipal power plant, using diesel-generator unit. To begin work soon.

New London plans improvements in municipal power plant, including new equipment. Surveys and estimates of cost will be made soon.

Jefferson has authorized surveys and estimates of cost for new municipal electric plant. Proposed to use diesel-generator units and accessories. K R Brown, Valley Bank Bldg, Des Moines, consulting engineer.

Bancroft will award contracts soon for municipal electric plant, including two 450-hp diesel-generator units and electrical distributing system. Cost about $100,000. A S Harrington, Baum Bldg, Omaha, Nebr., consulting engineer.

Muscatine Municipal Electric & Water Plants have awarded contract to Westinghouse Electric & Mfg Co, for 7500-kw turbine-generator and to Condenser Service & Engrg Co for surface condenser for municipal light and power plant.

New Hampton is considering three proposals for expansion in municipal electric power facilities, including (1) complete rebuilding of present station and equipment, cost estimated at $236,700; (2) improvements in present plant, cost estimated at $183,125; and (3) entirely new power plant, cost estimated $238,000. Ralph D Thomas & Associates, Inc, 1200 Second St S, Minneapolis, Minn., consulting engineer.

State Bd of Education, State House, Des Moines, contracted Murry Iron Works Co, Burlington, for steam turbine-generating unit for power house at State Teachers' College, Cedar Falls, at $27,690.

Veterans' Administration, Washington, D. C., has low bid at $37,598 from Allen Chambers, 1726 Hawthorne St, Independence, Mo., for boiler house at institution at Knoxville.

KANSAS——City Ice & Fuel Co, 6611 Euclid Ave, Cleveland, Ohio, contracted Frick Co, Waynesboro, Pa., for ice-making and refrigerating machinery for branch plant at Kansas City, at $195,448. Award has been made to Interstate Construction Co, Ridge Bldg, Kansas City, Mo., for 1-, 2- and 5-story building in Public Levee District, Kansas City, at $445,990, to be owned by municipality and occupied under lease. Entire cost close to $750,000. J W Radotinsky, Commercial National Bank Bldg, Kansas City, architect; Walter F Schulz, Shrine Bldg, Memphis, Tenn., engineer.

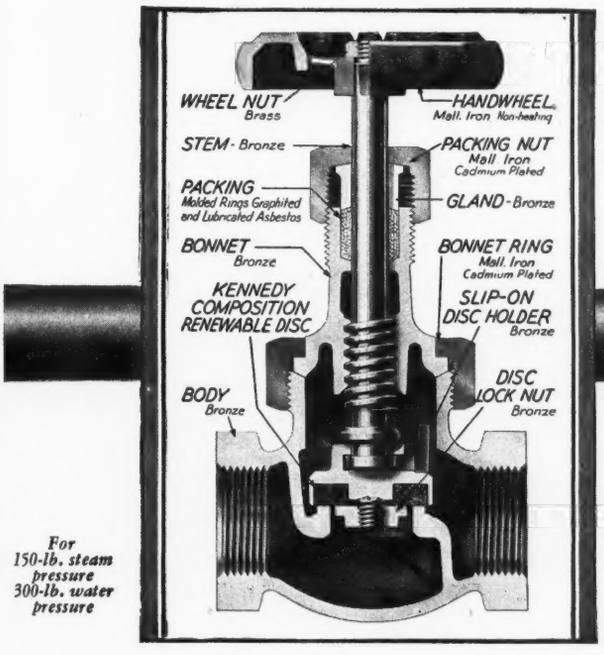
Osborne plans improvements in municipal electric plant, with installation of equipment for increased capacity. Cost about $50,000.

KENTUCKY——Bd of Education, Lexington, will award contracts soon for central-heating plant at junior high school. Frankel & Curtis, McClelland Bldg, Lexington, architects.

Burkesville will award contracts soon for diesel-generator units for municipal power plant. Estimated cost $65,000. consulting engineer.
J S Watkins, McClelland Bldg, Lexington,

A heavy standard bronze globe valve

for better service, longer wear, and easier maintenance



For 150-lb. steam pressure 300-lb. water pressure

The KENNEDY Fig. 89 Globe Valve

with Renewable Composition Disc

Some Additional Features of Kennedy Fig. 89

Disc holder has four prongs for guidance and to prevent binding

Raised seat in body is unusually high for longer disc life

Slip-on disc holder locks at wide-open position

Stem has large number of heavy contact threads to reduce wear

Conical joint between stem and bonnet permits packing under pressure

Stuffing box is exceptionally deep with molded packing and long gland follower

THE first things you will notice on examining a Kennedy Figure 89 Valve are its sturdy proportions and its attractive appearance. A specially interesting feature is the smooth silvery cadmium plating on the malleable iron union bonnet ring and packing nut. This distinctive finish will not chip off nor be easily marred from wrenches, provides permanent protection against rusting, and has a self-lubricating quality on the threads.

When you try out the operation of this new valve, notice how easily the valve opens and closes. This is because of a special machined low-friction contact surface between the stem head and the disc holder. Notice also the comfortable grip on the octagonal non-heating handwheel with the wheel nut below the level of the wheel so that it cannot burn the palm of the hand.

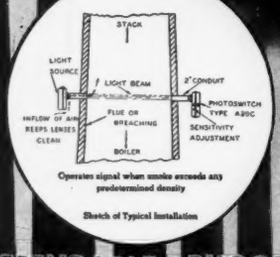
The outstanding features of Kennedy Fig. 89 makes it a distinct advance in heavy standard bronze globe valve design. Order some of these valves from your distributor and try them out at the first opportunity. You will find their easy operation, low maintenance expense and long life make them the best possible valve investment.

The Kennedy Valve Mfg. Co., Elmira, N. Y.

KENNEDY

Extra Values in VALVES and PIPE FITTINGS

PHOTOSWITCH
Electric Eye
INCREASES FUEL ECONOMY—AVOIDS SMOKE NUISANCE



DEPENDABLE—RUGGED
• GUARANTEED •

SOLVES YOUR OTHER CONTROL PROBLEMS

Wherever objects are counted, electrical machinery automatically controlled, or warning signals are used, PHOTOSWITCH will do the job better and more economically.

Write for Catalogue.

LOW IN COST

PHOTOSWITCH INCORPORATED
CAMBRIDGE • MASSACHUSETTS

District offices in all principal cities

YOUR

Dependable Guide

. . . to the big things and little things done each month by operators and manufacturers across the country to raise plant efficiencies, cut costs, and reduce trouble.

It Pays You to

Read POWER Regularly

LOUISIANA——Wackman Welded Ware Co, 2412 S 7th St, St. Louis, Mo., plans 1-story plant, 100 x 600 ft, in Goosport district, Lake Charles, for manufacture of steel barrels, drums, etc. Power house will be built. Cost about $100,000.

St Charles Hotel, New Orleans, plans air-conditioning system in part of hotel. Bids will be asked soon. Leo S Weil and Walter B Moses, 427 S Peters St, engineers.

Rapides Packing Co, Alexandria, is considering rebuilding of meat-packing plant, with boiler house, recently destroyed by fire. Loss estimated about $75,000.

Houma has voted bonds of $250,000 for municipal natural-gas distributing system, including welded-steel pipeline for connection with source of supply and control station. About 170,000 lin ft of pipe will be required. T Baker Smith, city engineer.

MARYLAND——Rustless Iron & Steel Corp, 2400 East Chase St, Baltimore, plans expansion in plant, comprising several large 1- and multi-story units. Increased power equipment will be installed for operation. Cost estimated close to $1,000,000.

MASSACHUSETTS——New England Mutual Life Insurance Co, 87 Milk St, Boston, plans central-heating and power plant in new 4- and 10-story office building at Boylston, Clarendon and Newbury Sts. Cost about $2,500,000. Cram & Ferguson, 248 Boylston St, and Shaw & Hepburn, 141 Milk St, both Boston, associated architects.

MICHIGAN——Michigan Consolidated Gas Co, 415 Clifford St, Detroit, plans welded-steel pipeline from connection with present system, near Milan, to Ann Arbor, about 21 mi, for natural-gas transmission for distribution in latter district. Cost about $150,000, with booster and control station.

Holland has low bid at $216,780 from Edge Moor Iron Works, for boilers and equipment for municipal power plant, and will make award soon. Hamilton & Weeber, Grand Rapids, consulting engineers.

Northern Pipe Line Co, Mount Pleasant, plans welded-steel pipeline from gas field area in Arenac County, to Midland, about 45 mi, for natural-gas transmission. Connection will be made at latter point with system of Consumers Power Co, Jackson, for distribution in Bay City and Saginaw districts. Booster stations will be installed along route. Cost about $150,000.

Schust Baking Div of Loose-Wiles Biscuit Co, Saginaw, has approved plans for additions to cost about $150,000, with traveling ovens and other equipment. Work will be done during summer. Main offices of parent company are at 1100 West Eighth St, Kansas City, Mo.

American Cyanamid & Chemical Corp, 30 Rockefeller Plaza, New York, N. Y., plans plant at Kalamazoo, consisting of several 1-story units, to replace smaller factory at same place. Cost close to $300,000.

Bd of Education, Battle Creek, plans new central-heating plant at Lakeview school this summer. L J Sarvis, Battle Creek, architect.

MINNESOTA —— Madison will award contracts soon for equipment for municipal power plant, including coal- and ash-handling machinery, feed-water heater, and combustion-control apparatus. Enlargement of station will cost about $182,000. Perkins & McWayne, Paulton Blk, Sioux Falls, S. D., consulting engineers.

Hibbing has low bid from Westinghouse Electric & Mfg Co, for steam turbine-generator unit, surface condenser and equipment for municipal generating and heating plant, and will make award soon. Burlingame, Hitchcock & Estabrook, Inc, Sexton Bldg, Minneapolis, consulting engineers.

MISSISSIPPI —— Clarksdale contracted Rust Engrg Co, Clark Bldg, Pittsburgh, Pa., for boiler unit for municipal power plant, including installation, and piping; also to Fairfield Engrg Co, Marion, Ohio, for coal-handling and storage equipment; to Westinghouse Electric & Mfg Co, for parts replacements in turbine unit and accessories; and to Memphis Construction Co, Memphis, Tenn., for erection of plant addition. Stevens & Johnson, Starkville, consulting engineers.

MISSOURI——El Dorado Springs contracted Worthington Pump & Machinery Corp at $66,751 for diesel-generator unit for new municipal power plant; also to Atkinson Armature Works, Pittsburg, Kan., for switchboard. W B Rollins & Co, Railway Exchange Bldg, Kansas City, consulting engineer.

Chevrolet Motor Co, Div of General Motors Corp, 3044 West Grand Blvd, Detroit, Mich., has approved plans for 1-story addition to branch assembling plant at 6801 East 37th St, Kansas City, totaling 40,000 sq ft of floor space. Cost over $100,000. Will also build 1-story branch assembling plant, 121 x 720 ft, at Atlanta, Ga. Cost over $350,000. Albert Kahn, Inc, New Center Bldg, Detroit, architect and engineer.

Macon has low bid from Ebbe Construction Co, Trenton, at $61,924 for addition to municipal electric power plant and waterworks station, 95 x 165 ft, and will make award soon. Equipment contracts will be placed separately. Entire project will cost about $200,000. Baumes Engrg Co, Railway Exchange Bldg, St. Louis, consulting engineer.

Bd of Directors, Federal Reserve Bank, Tenth St and Grand Ave, Kansas City, has approved plans for power plant in building, with three 370-hp gas-engine-generator units. Clifford H Carr, 405 East 13th St, consulting engineer.

NEBRASKA——The Loup River Public Power District, Columbus, has awarded contract for 15,000-kw, 13,800-v, 60-cycle generator, condenser, etc, to the Westinghouse Electric & Mfg Co, at $85,440.

Jerpe Commission Co, 12th and Douglas Sts, Omaha, contracted John Lof & Sons, 4012 Lake St, for 7-story and basement cold-storage and refrigerating plant at 101 S 12th St. Cost over $100,000. Smith, Brubaker & Egan, 30 North LaSalle St, Chicago, Ill., architects.

Lincoln contracted W H Bixby, Inc, Hubbell Bldg, Des Moines, Iowa, for stoker and accessories, combustion-control apparatus, mechanical fans and ducts for municipal electric power plant, at $15,683. Black & Veatch, 4706 Broadway, Kansas City, Mo., consulting engineers.

Lincoln Non-Stock Co-operative Milk Producers Assn, 832 North First St, Lincoln, plans power house at milk-processing and distributing plant. To be built this summer. Cost about $150,000. E F Klinger, Amery, Wis., architect.

NEW JERSEY——Continental Can Co, 100 East 42nd St, New York, N. Y., has contracted Austin Co, 16112 Euclid Ave, Cleveland, Ohio, for 5-story and basement plant on Monmouth St, Jersey City, and will begin erection soon. Cost about $850,000.

NEW MEXICO —— Texas-New Mexico Pipe Line Co, Hobbs, contracted Carlson Construction Co, Pampa, Tex., for 5-in. welded-steel pipeline from oil-field district at Lovington, to connection with main pumping station at Monument, about 16½ mi, for crude-oil transmission. Pumping stations will be installed for booster service along route. Line will have capacity of about 6000 bbl per day. Cost over $100,000.

NEW YORK——Cashman Laundry Corp, 340 Gerard Ave, Bronx, New York, plans cold-storage plant for fur-storage on adjoining site. Cost about $100,000, with equipment.

Marine Garden Apartments, Inc, 420 Lexington Ave, New York, plans central-heating plant in two 12-story apartment buildings at Neptune Lane and Echo Ave, New Rochelle, N. Y., on adjoining sites. Cost about $1,500,000. George F Pelham, Jr, 100 East 42nd St, New York, architect.

Estate of Benjamin L M Bates, New York, care of Sylvan Bien, 415 Lexington Ave, architect, plans central-heating plant in 24-story apartment house on Park Ave, 40th to 41st St, site of present Murray Hill Hotel, which will be razed. Cost about $2,500,000.

OHIO——Bd of Directors, Dennison University, Granville, will award contracts soon for improvements in power house, with boilers, and stokers. A M Kinney, Inc, Carew Tower Bldg, Cincinnati, consulting engineer.

Kroger Grocery & Baking Co, 35 East 7th St, Cincinnati, plans steam-electric generating station at branch bakery and distributing plant at 2210 Lockburne Rd, Columbus, to cost about $50,000. A M Kinney, Inc, Carew Tower Bldg, Cincinnati, consulting engineer.

Norwalk plans improvements in municipal power plant, including boiler unit. Cost about $80,000.

Amherst plans call for bids in July for municipal electric plant, to include two 3000-sq-ft boilers, two 400-kw engine-generator units, and switchboard. Cost about $150,000. Financing has been arranged through Federal aid. Floyd G Browne, Marion, consulting engineer.

FOR RECORD MAKING PERFORMANCE

When maximum rope operating economy, with maximum safety, are the requirements...specify Roebling "Blue Center." ★ The highest achievement of Roebling's over 90 years of rope making experience!

JOHN A. ROEBLING'S SONS COMPANY, TRENTON, N.J.

BRANCHES IN PRINCIPAL CITIES

STRONGER—Wire of highest strength consistent with ductility and toughness

TOUGHER—Provides maximum resistance against wear, sudden shocks, vibration

SAFER—Unequalled for uniformity of quality

SAVING—Insures lowest general average operating cost

THE HIGHEST DEVELOPMENT IN ROEBLING WIRE ROPE

ADVERTISING PAGES REMOVED

A FIRE SENTENCED TO DIE

In 3 Seconds!

Here's a sure-handed, dependable weapon against fire. It kills blazes with the fastest known extinguishing agent—carbon dioxide snow-and-gas. It spells sudden death to fire! It harms nothing but fire.

LUX extinguishers and LUX Built-In Systems are *engineered for industry*. LUX protects vital processes, costly and delicate equipment. Old-fashioned extinguishing methods are not good enough for industry. Industry wants the speed, precision and safety of LUX equipment.

Electrical and flammable liquid fires—industry's worst hazards—are no problem in a LUX-equipped plant. Send the coupon. Get the facts now.

Announcing Kidde-LUX

Easy one-handed operation and trigger action make this new Kidde-LUX Model Two a sensational success against smaller fires. Aim it . . . pull the trigger . . . LUX snow-and-gas smothers the blaze. No pumping to disturb your aim. *Just fire at the fire!* Send the coupon for information on this newest fire-fighter, priced at $10.85.

LUX SNUFFS OUT FIRE

Walter Kidde & Company
624 West Street, Bloomfield, N. J.

Send me "Instant Death To Fire". I understand it describes the new Kidde-LUX as well as other LUX extinguishers.

Name .....

Company .....

Address .....

Mansfield plans municipal power plant in connection with sewage-disposal works, using gas produced as byproduct of latter station for operation. Estimates of cost are being made. W C Statler, City Hall, city engineer.

U. S. Army Air Corps, Wright Field, Dayton, will award contract soon for 2-story laboratory building, 50 x 200 ft, for power plant at field. Equipment awards will be made separately.

North Baltimore plans municipal electric power plant, including two 450-hp, and one 375-hp, diesel-generator units. Extensions will be made in lighting system. Cost about $195,000. C J Simon, Van Wert, consulting engineer.

Troy will award contracts soon for equipment for municipal electric plant, including generator unit and for extensions in overhead and underground distribution lines. Froehlich & Emery Engrg Co, Second National Bank Bldg, Toledo, Ohio, consulting engineer.

Sears, Roebuck & Co, Chicago, Ill., contracted York Ice Machinery Corp for installation of air-conditioning system in store building at 2900 Reading Rd, Cincinnati, at $43,200.

Delphos has authorized surveys and estimates of cost for new municipal electric plant. Diesel-generator units will be considered. John A Motzner and Charles Smith are members of committee in charge.

OKLAHOMA —— Phillips Petroleum Co, Bartlesville, plans improvements in oil-refining plant at Kansas City, Kan., including installation of power and pumping facilities, steel tank storage and other equipment. Cost about $750,000.

Fairview contracted Fairbanks, Morse & Co, at $60,000 for improvements in municipal power plant, including remodeling of diesel units.

OREGON —— Eastern Oregon Onion Growers' Assn, Ontario, plans air-conditioning system in 1-story packing and storage plant, 60 x 200 ft, on site near town. Boiler house is being considered. Cost about $40,000.

Washington Veneer Co, Olympia, Wash., is considering new branch mill at Springfield, where site is being secured. Power house will be built. Cost estimated over $400,000.

Terminal Ice & Cold Storage Co, Hillsboro, has approved plans for 1-story cold-storage and refrigerating plant, 100 x 130 ft. Cost over $65,000.

PENNSYLVANIA——Pittsburgh Housing Authority, Law & Finance Bldg, Pittsburgh, plans central-heating plant in housing development in Bedford district. Cost about $3,000,000. Marlier, Lee, Boyd & Prack, Fulton Bldg, Pittsburgh, architects.

SOUTH DAKOTA——Construction Service, Veterans' Administration, Washington, D. C., will receive bids until July 5 for boiler and boiler plant equipment for power house at institution at Hot Springs.

TENNESSEE——Thomas Winsett, McKenzie, plans 1-story cold-storage and refrigerating plant, with locker system. Cost close to $27,000, with equipment.

TEXAS——Center is considering municipay natural-gas distributing system, with control station and operating facilities. Cost about $40,000.

Quartermaster, William Beaumont General Hospital, El Paso, has low bid from Harry R Byers Co, Denver, Colo., at $57,867 for furnishing and installing two 2500-sq-ft and two 1500-sq-ft water-tube boilers in power house at hospital, and will place award soon.

Weimar plans purchase of local privately-owned power plant and will operate as municipal property. Will install additional equipment. Bond issue of $50,000 is being arranged.

Temple has plans for municipal electric plant. Proposed to use diesel-generator units. Bond issue of $850,000 is being arranged for new plant, electrical distributing lines and street-lighting.

San Augustine has low bid from Fairbanks, Morse & Co, for equipment for municipal electric plant, and will make award soon. Will also let contract for erection of station building. H B Gieb & Co, Mercantile Bldg, Dallas, consulting engineers.

Lexington has authorized bonds for $54,000 for purchase of local privately-owned power plant which will be operated as municipal property. Improvements planned, including consolidation with waterworks station.